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ABSTRACT

Rock Cycle is one of the units of a K-6 unified science curriculum program. The unit consists of four organizing sub-themes: (1) chemistry (introducing the topics of matter, elements, compounds, and chemical bonding); (2) characteristics (presenting hands-on activities with rocks and minerals); (3) minerals (emphasizing the aesthetic and economic importance of mineral substances); and (4) rocks (with investigations on the composition, types, and identification of rocks). Each sub-theme contains an introductory statement, student activities for lower primary grades (K-3) and upper primary grades (4-6), and a teacher's copy for each student worksheet. Student worksheets are ready for duplicating. (ML)

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ROCK CYCLE

CHEMISTRY

The word chemistry means different things to individuals. To many children it means bottles and beakers filled with substances possessing "mysterious powers." Many see chemistry as a difficult science that only bright children can understand. But chemistry is all around us. Chemistry deals with all the things that make up the earth; why substances behave as they do; how things are put together; and how things interact with one another. In the lower primary grades introducing the meaning of matter and elements is important. In the upper primary grades chemistry should include compounds and binding. This chemistry unit is included in the Rock Cycle because minerals can be "hands on" activities for your students.

LOWER PRIMARY

A. WHAT IS MATTER? - Can you see, smell or touch matter? Am I matter? What is mass? Does matter take up space? Is everything made of matter?

B. WHAT MAKES UP MATTER? - What is a solid? What is a liquid? What is a gas? What are properties of matter?

C. WHAT ARE ELEMENTS? - Are elements pure substances? How many elements are there? Where do elements come from? Do elements have properties? What is the periodic table? What do the symbols mean? What are the most important elements?

UPPER PRIMARY

D. WHAT ARE COMPOUNDS? - What are compounds made of? How many elements make a compound? Can any combination of elements make a compound? Can compounds be broken into their original elements? Do compounds have properties different from the elements that make them ?

E. WHAT IS BONDING? - What is a bond? How do things bonds? How does bonding control what something looks like?

SE 046347

K - 6 Science Curriculum

Joint Project by Math Science Nucleus
and U.S. Geological Survey

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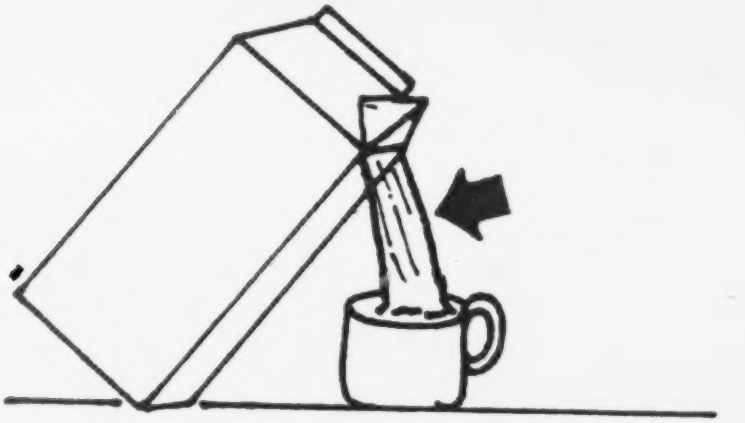
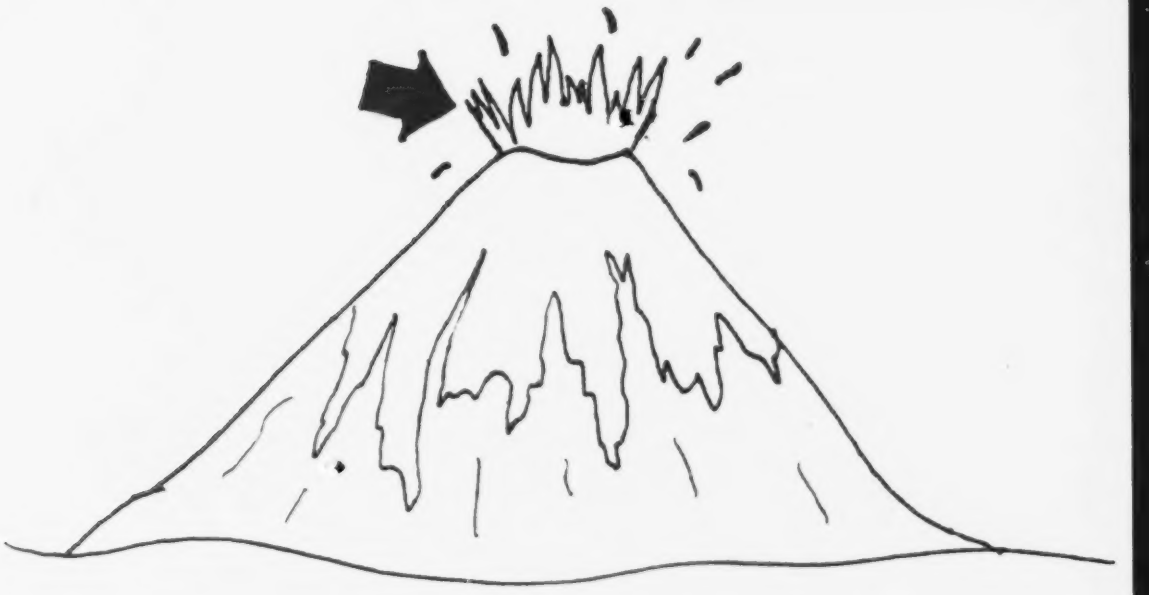
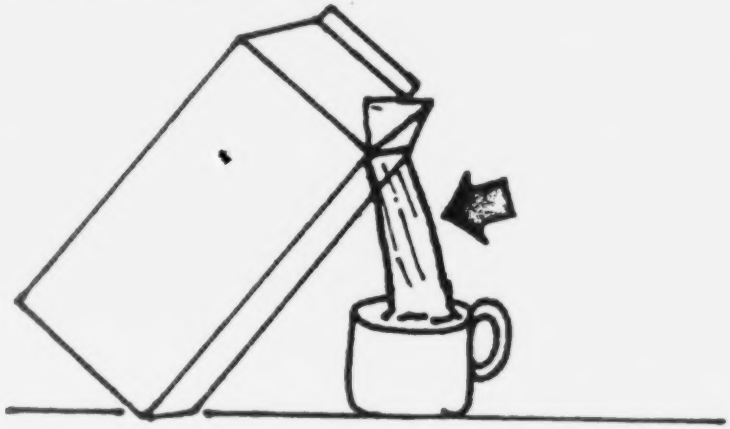


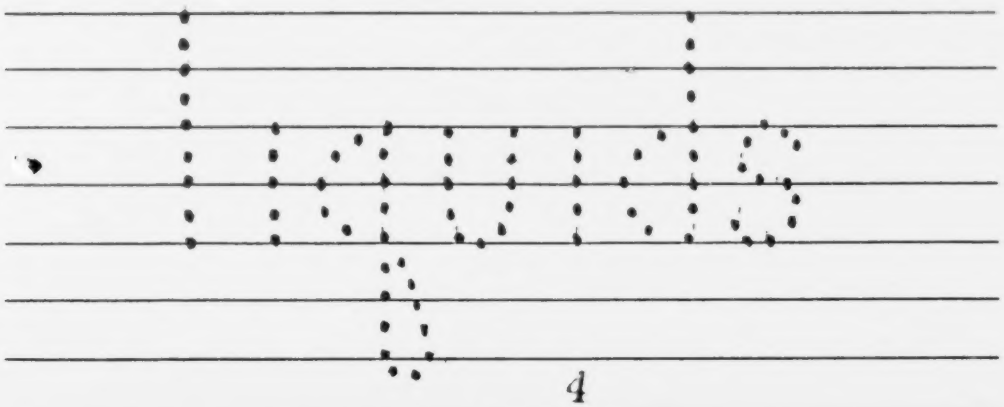


Name _____ TEACHER SHEET

HAVE STUDENTS COLOR THE PICTURES BELOW AND LEARN THE WORD LIQUID BY WRITING IT AND BY LOOKING AT THE PICTURES.



LIQUID STATE: characterized by (1) a definite volume, (2) lack of a definite shape, (3) high density, and (4) slight expansion and contraction. (Children may notice that liquids take the shape of their container as does the gases)



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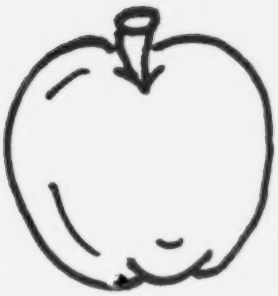
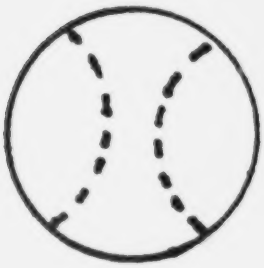
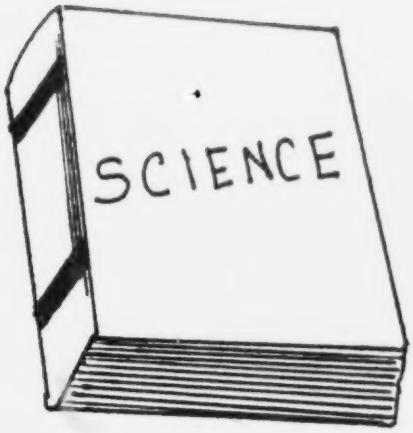
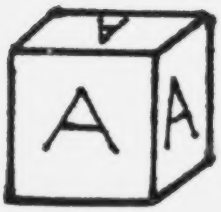
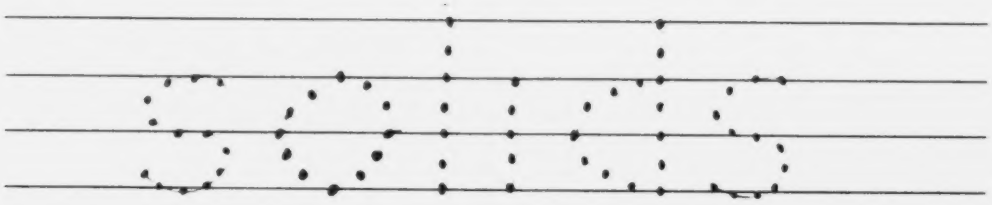




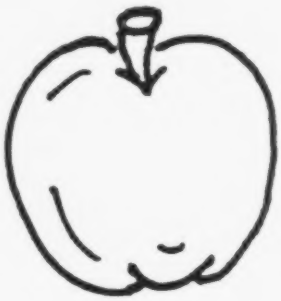


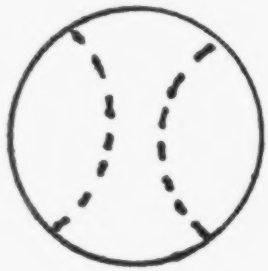


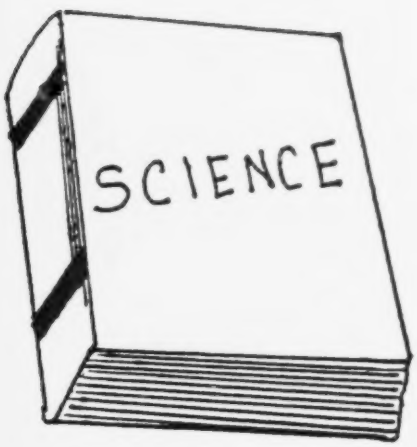


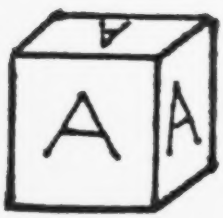
Name _____ TEACHER SHEET

SOLID STATE: characterized by (1) definite shape, (2) definite volume, (3) still higher density than liquids, and (4) very slight contraction and expansion.

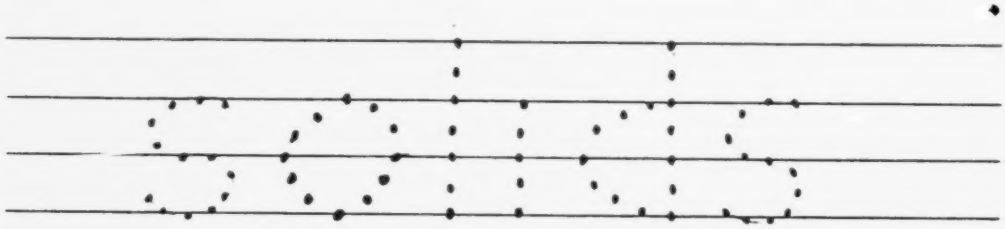








HAVE STUDENTS COLOR THE PICTURES ABOVE AND LEARN THE WORD SOLID BY WRITING IT AND BY LOOKING AT THE PICTURES.



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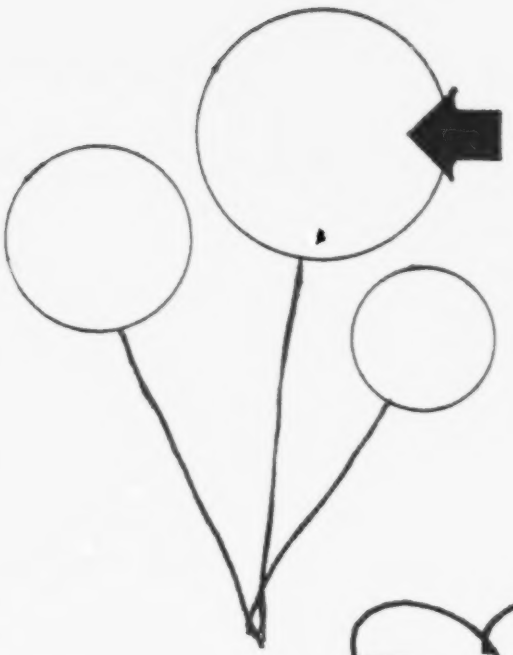
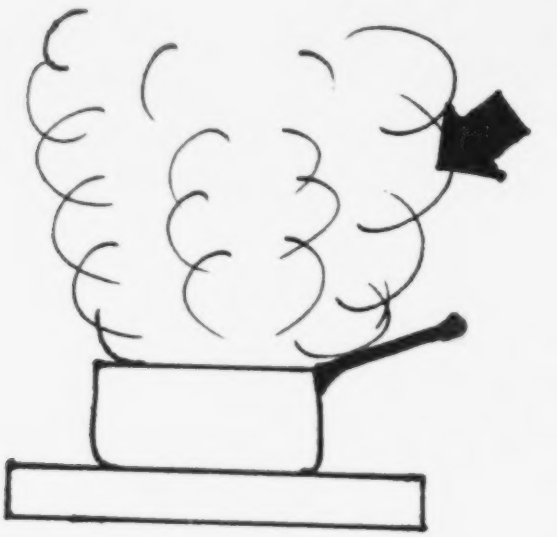
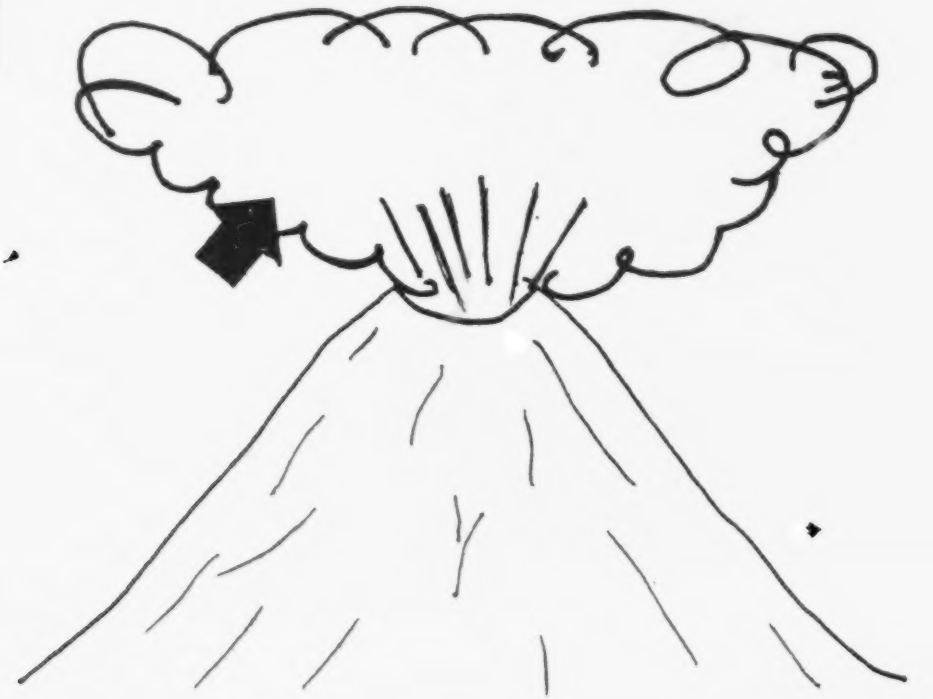
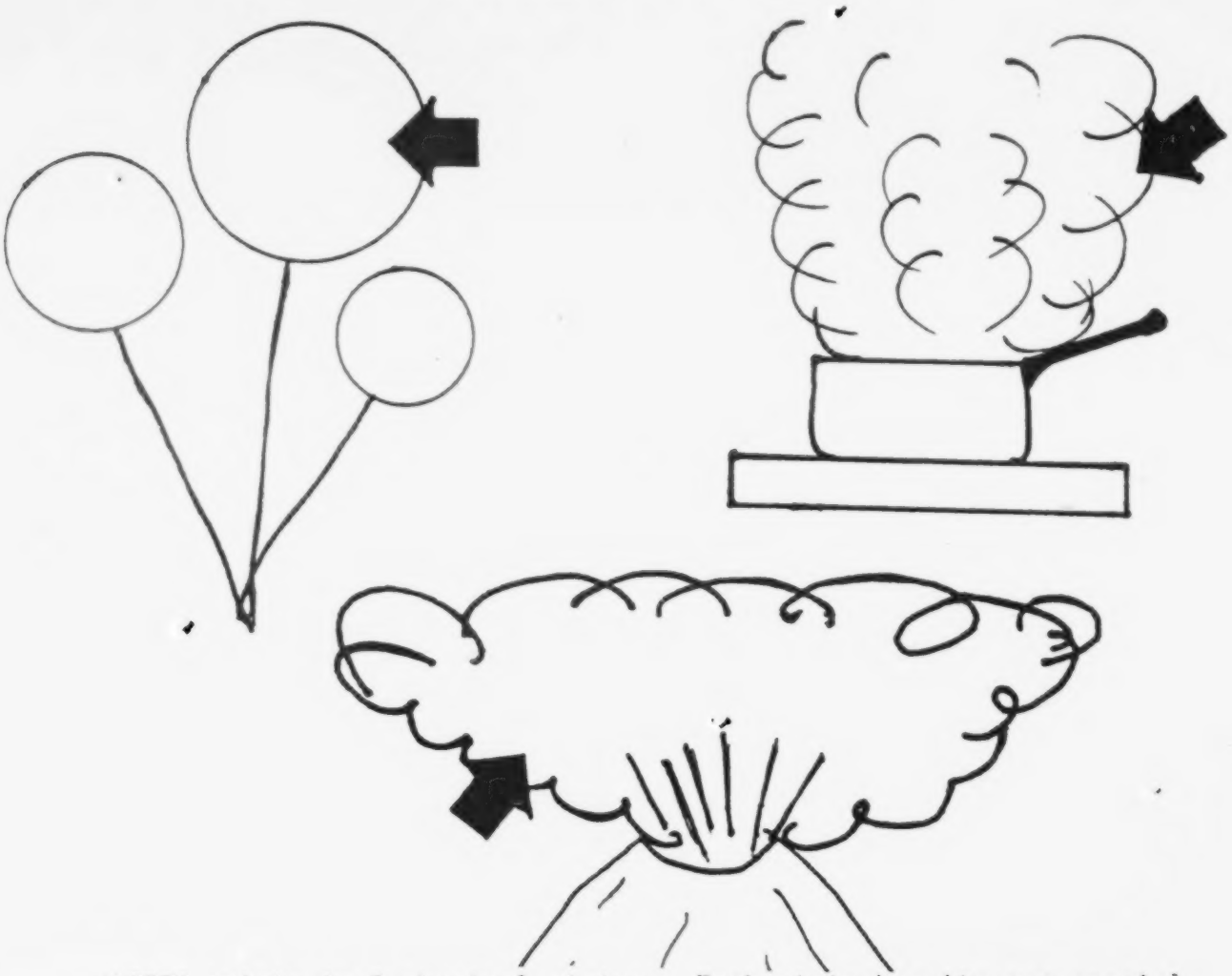






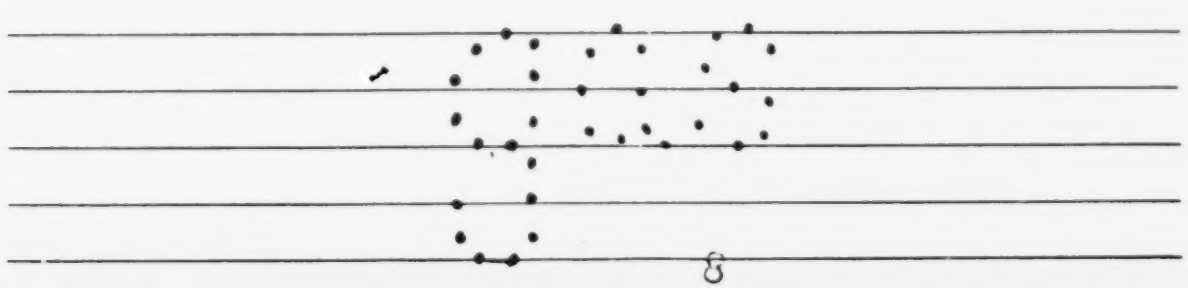
Name _____ TEACHER SHEET

HAVE STUDENTS COLOR THE PICTURES BELOW AND LEARN THE WORD GAS BY WRITING IT AND LOOKING AT THE PICTURES.



MATTER exists in 3 physical states. Each state has its own special characteristics.

GASEOUS STATE: characterized by (1) lack of definite shape and volume, (2) low density, and (3) easy contraction and expansion. (Children may describe gases as being light, colorless, invisible, float, etc.)



Name: _____ TEACHER SHEET

Everything on earth is made up of stuff we call MATTER.

* All matter takes up space and has weight.

Which things below are matter ?

1. cat (yes) no
2. milk (yes) no
3. book (yes) no
4. water (yes) no
5. shoe (yes), no
6. steam (yes) no
7. hat (yes) no

HAVE STUDENTS CIRCLE THOSE ITEMS WHICH TAKE UP SPACE AND HAVE WEIGHT. CONCLUSION: EVERYTHING IS MADE OF MATTER.

Name: _____

Everything on earth is made up of stuff we call MATTER.

* All matter takes up space and has weight.

Which things below are matter ?

1. cat yes / no
2. milk yes / no
3. book yes / no
4. water yes / no
5. shoe yes / no
6. steam yes / no
7. hat yes / no

Name _____ TEACHER SHEET

SEE FOLLOWING PAGE FOR INSTRUCTIONS TO ACTIVITY BASED ON THE PERIODIC TABLE OF THE ELEMENTS.

PERIODIC TABLE OF THE ELEMENTS

1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La *	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 TI	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89 * Ac															

*	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
*	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

* Lathanides

* Actinides

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PERIODIC TABLE OF THE ELEMENTS CONT.

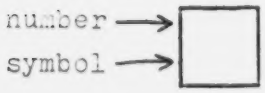
Using the following key, have students make a color-coded periodic table of the elements.

COLOR-CODING THE PERIODIC CHART USING PHYSICAL STATES:

Elements marked with this symbol color blue, these are the GASES.

Elements marked with this symbol color red, these are the LIQUIDS.

Elements marked with this symbol color green, these are the SYNTHETIC or man-made elements.



Color all the remaining elements yellow, these are the SOLIDS.

Name _____

PERIODIC TABLE OF THE ELEMENTS

1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La **	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 TI	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89 Ac *															

**	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
*	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

** Lathanides

* Actinides

ABUNDANT ELEMENTS IN THE CONTINENTAL CRUST

Element	Symbol	Weight Per cent	Atom Per cent	Volume Per cent
Oxygen	O	46.40	61.85	94.27
Silicon	Si	28.15	21.40	.88
Aluminum	Al	8.23	6.51	.47
Iron	Fe	5.63	2.15	.48
Magnesium	Mg	4.15	3.64	.58
Calcium	Ca	2.36	1.26	.68
Potassium	K	2.33	1.26	1.65
Sodium	Na	2.09	1.94	.99
Totals		99.34	100.00	100.00

Economic Elements in the Earth's Crust

Element	Symbol	%
Aluminum	Al	8.1
Iron	Fe	5.0
Potassium	K	2.6
Magnesium	Mg	2.1
Titanium	Ti	0.44
Hydrogen	H	0.14
Phosphorus	P	0.12
Manganese	Mn	0.10
Fluorine	F	0.07
Sulphur	S	0.05
Chlorine	Cl	0.020
Vanadium	V	0.017
Chromium	Cr	0.009 6
Zinc	Zn	0.008 2
Nickel	Ni	0.008
Copper	Cu	0.005 8
Cobalt	Co	0.002 8
Lead	Pb	0.000 10
Boron	B	0.000 7
Beryllium	Be	0.000 20
Arsenic	As	0.000 20
Tin	Sn	0.000 15
Molybdenum	Mb	0.000 12
Uranium	U	0.000 16
Tungsten	W	0.000 10
Silver	Ag	0.000 008
Mercury	Hg	0.000 002
Platinum	Pt	0.000 000 5
Gold	Au	0.000 000 2

Chemical Content of Sea Water

	g/l
sodium, Na	10.56
magnesium, Mg	1.30
calcium, Ca	0.40
potassium, K	0.38
chlorine, Cl	19.00
sulphate, SO_4	2.65
bicarbonate, HCO_3	0.14
bromine, Br	0.06

Name: _____ TEACHER SHEET

Major Elements In The Human Body

HAVE STUDENTS LEARN THE MAJOR ELEMENTS BY COMPLETING THE NAMES OF THE ELEMENTS BELOW. EACH ONE BEGINS WITH ITS SYMBOL.

Symbol	complete the words
O	X Y G E N.
C	A R B O N.
H	Y D R O G E N.
N	I T R O G E N.
Ca	L C I U M.
P	H O S P H O R U S.

Name: _____

Major Elements In The Human Body

Symbol Complete the words

O _ _ _ _ _.

C _ _ _ _ _.

H _ _ _ _ _ _ _.

N _ _ _ _ _ _ _.

Ca _ _ _ _ _.

P _ _ _ _ _ _ _ _ _ _.

Name _____ TEACHER SHEET

Main Earth's Crust Elements

STUDENTS LEARN ELEMENT NAMES AND SYMBOLS THROUGH THIS EXCERCISE. PENMANSHIP AND MEMORIZATION SKILLS ARE ALSO PRACTICED.

	Element:	Symbol:
1.	OXYGEN	O
2.	Silicon	SiO_2
3.	ALUMINUM	Al
4.	IRON	Fe
5.	Magnesium	Mg
6.	Calcium	Ca
7.	SODIUM	Na
8.	Potassium	K

Name _____

Main Earth's Crust Elements

	Element:	Symbol:
1.	_____	O
2.	Silicon	_____
3.	_____	Al
4.	_____	Fe
5.	Magnesium	_____
6.	Calcium	_____
7.	_____	Na
8.	Potassium	_____

Name _____ TEACHER SHEET

CONTINUATION OF CHEMICAL SYMBOLS AND ELEMENT NAME RECOGNITION. *** ALL 4 EXCERCISES ARE DESIGNED NOT ONLY FOR LEARNING THE MAJOR ELEMENTS AND THEIR SYMBOLS, BUT TO SEE THE ELEMENTS MOST IMPORTANT IN OUR ATMOSPHERE, OUR BODIES, THE EARTH'S CRUST AND THOSE IN SEAWATER. ***

Major Elements In The Atmosphere

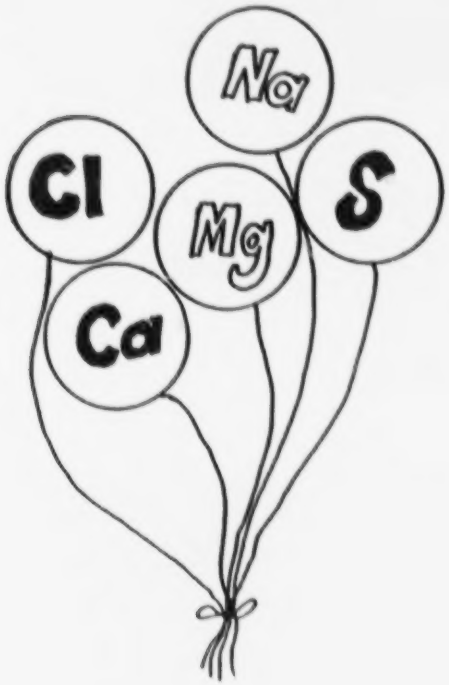
Element:	Symbol:
Nitrogen	N
Oxygen	O
Argon	Ar
Carbon Dioxide	CO_2

Name _____

Major Elements In The Atmosphere

Element:	Symbol:
Nitrogen	_____
Oxygen	_____
Argon	_____
Carbon Dioxide	_____

These 5 elements are the major ingredients of "salty" water. (They are the top 5) Have students practice penmanship and also learn their chemical symbols.



TEACHER SHEET

name

Cl • chlorine

Na • sodium

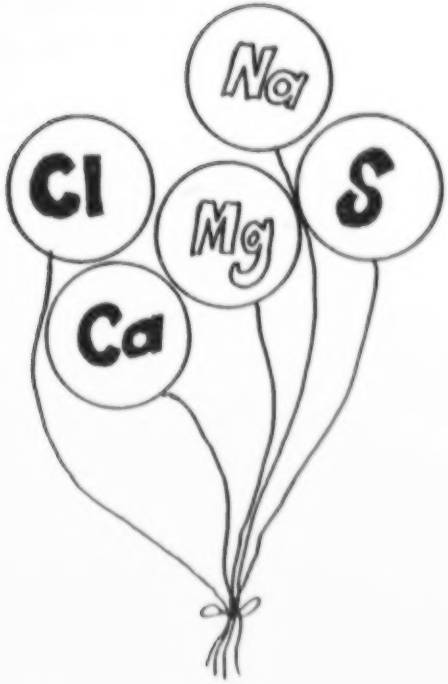
Mg • magnesium

S • sulfur

Ca • calcium

PLACE IN THE CORRECT SYMBOL

Major Elements dissolved in Seawater



name:

chlorine

sodium

magnesium

sulfur

calcium

↑ place the correct symbol

Major Elements dissolved in Seawater

NAME TEACHER SHEET

ELEMENTS

On a seperate sheet of paper, list all the different types of matter in your classroom. Don't forget that more than one type of matter can be present in one object. For example, a wooden pencil not only has wood but also contains an eraser made of rubber, paint on the surface and a metal ring holding the eraser in place.

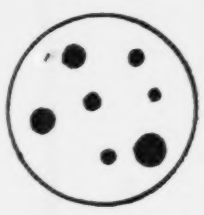
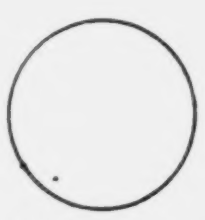
As you probably guessed, this list could go on forever. If your not sure if an item is made up of matter, simply ask yourself if the object in question takes up space and has weight. If the answer is yes, then put it on your list.

Did you find anything that was not made of matter ? If so, what?

STUDENTS SHOULD FIND THAT EVERYTHING IS MADE OF MATTER.

ALL THE THINGS ON YOUR LIST IS MADE FROM A TOTAL OF 103 SEPERATE SUBSTANCES CALLED ELEMENTS. (the number changes as more elements are discovered)

An element is something that is in pure form. It is made of the exact same "stuff" throughout.

I.  II. III. 

Which of the balls drawn represents something that is pure? NUMBER THREE

Why? BECAUSE IT IS ALL THE SAME THROUGHOUT, NO IMPURITIES.

Your problably thinking: How is it possible for all the things in the world to be made from only 103 or so elements? Well, just as our 26-letter alphabet when put together in all sorts of combinations makes up our english language, the 103 elements in a similiar fashion

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Penny Quiz

1. _____

2. _____

3. _____

combine to form the almost countless varieties of matter on our earth.

How many words can you make from these three alphabet letters: e, r and a ? ERA, AREA, EAR AND REAR

Here is an example of some elements that combine to form new matter:

elements - Cl (chlorine)
Na (sodium)
K (potassium)
Ag (silver)
O (oxygen)

combinations - NaCl (sodium chloride)
AgCl (silver chloride)
KCl (potassium chloride)
$KClO_4$ (potassium perchlorate)

A chart which shows all 103 elements was developed by a Russian scientist known as Dmitri Ivanovich Mendeleyev. This chart is called THE PERIODIC CHART OF THE ELEMENTS. This chart lists all 103 elements in order from left to right and uses symbols to represent the elements full name. For example: H for hydrogen, O for oxygen and Al for aluminum. Sometimes the latin name for an element is used, so you have a symbol like K for potassium (Kalium in latin).

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NAME_____

ELEMENTS

On a seperate sheet of paper, list all the different types of matter in your classroom. Don't forget that more than one type of matter can be present in one object. For example, a wooden pencil not only has wood but also contains an eraser made of rubber, paint on the surface and a metal ring holding the eraser in place.

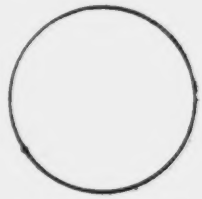
As you probably guessed, this list could go on forever. If your not sure if an item is made up of matter, simply ask yourself if the object in question takes up space and has weight. If the answer is yes, then put it on your list.

Did you find anything that was not made of matter ? If so, what?

_____

ALL THE THINGS ON YOUR LIST IS MADE FROM A TOTAL OF 103 SEPERATE SUBSTANCES CALLED ELEMENTS. (the number changes as more elements are discovered)

An element is something that is in pure form. It is made of the exact same "stuff" throughout.



Which of the balls drawn represents something that is pure?____

_____

Why? _____

Your problably thinking: How is it possible for all the things in the world to be made from only 103 or so elements? Well, just as our 26-letter alphabet when put together in all sorts of combinations makes up our english language, the 103 elements in a similiar fashion

combine to form the almost countless varieties of matter on our earth.

How many words can you make from these three alphabet letters: e, r and a ? _____

_____

Here is an example of some elements that combine to form new matter:

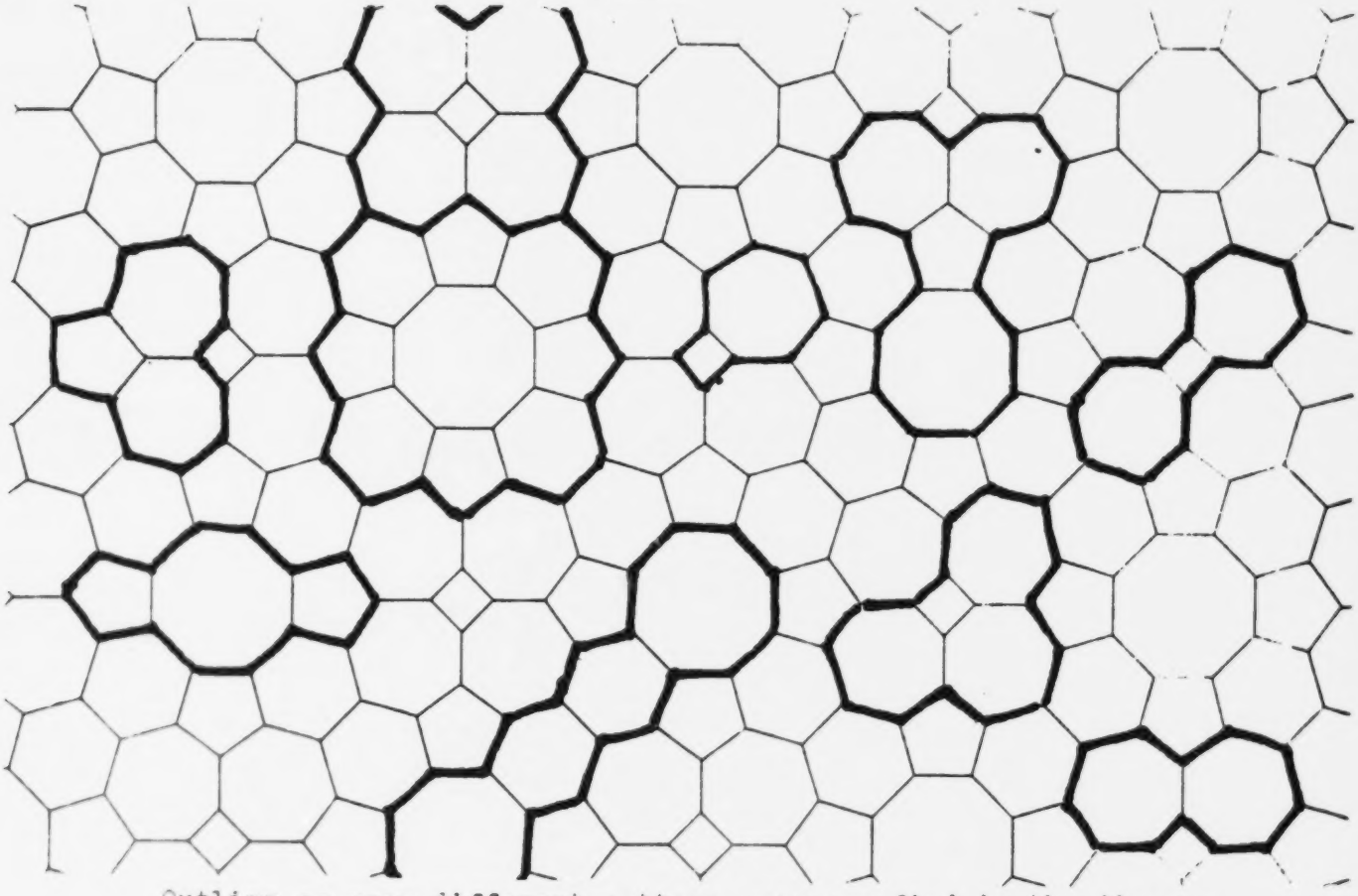
elements - Cl (chlorine)
Na (sodium)
K (potassium)
Ag (silver)
O (oxygen)

combinations - NaCl (sodium chloride)
AgCl (silver chloride)
KCl (potassium chloride)
$KClO_4$ (potassium perchlorate)

A chart which shows all 103 elements was developed by a Russian scientist known as Dmitri Ivanovich Mendeleyev. This chart is called THE PERIODIC CHART OF THE ELEMENTS. This chart lists all 103 elements in order from left to right and uses symbols to represent the elements full name. For example: H for hydrogen, O for oxygen and Al for aluminum. Sometimes the latin name for an element is used, so you have a symbol like K for potassium (Kalium in latin).

NAME TEACHER SHEET

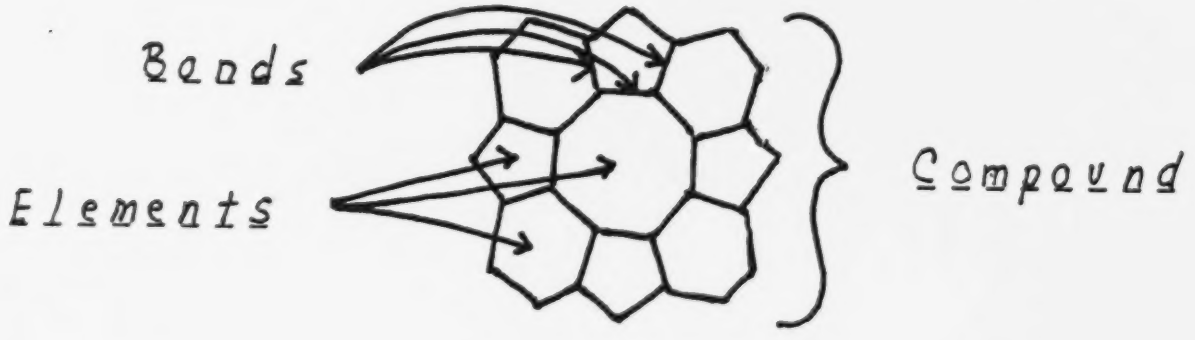
BONDING



Outline as many different patterns you can find in the diagram above using a different color for each. How many can you find? 10 - 20

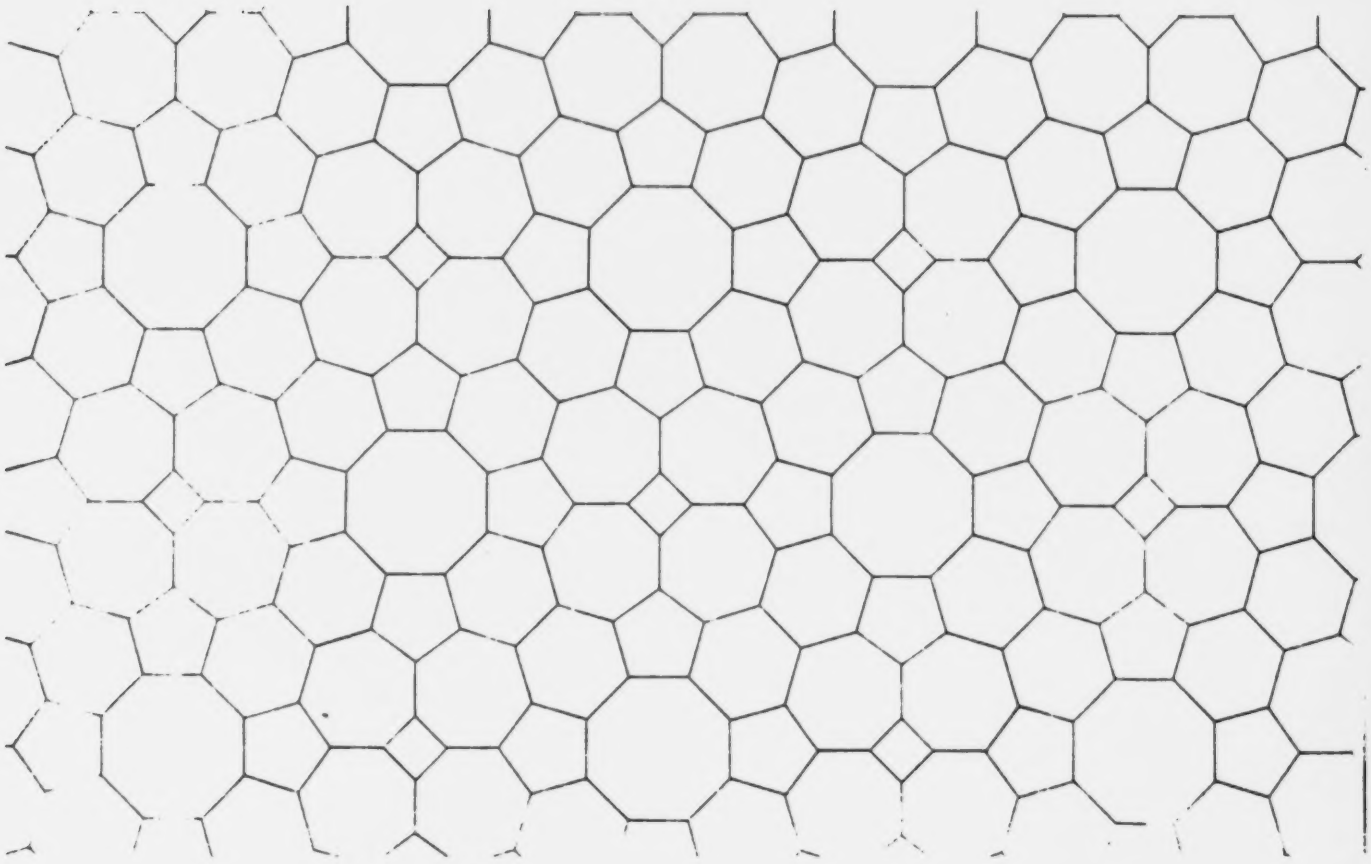
Each different colored shape represents a compound (remember, a compound is made up of elements). Each seperate unit within each shape represents the elements. The lines seperating each unit within a shape are the bonds holding the compound together. Bonds are the forces which hold together the elements that form compounds.

Example:



NAME_____

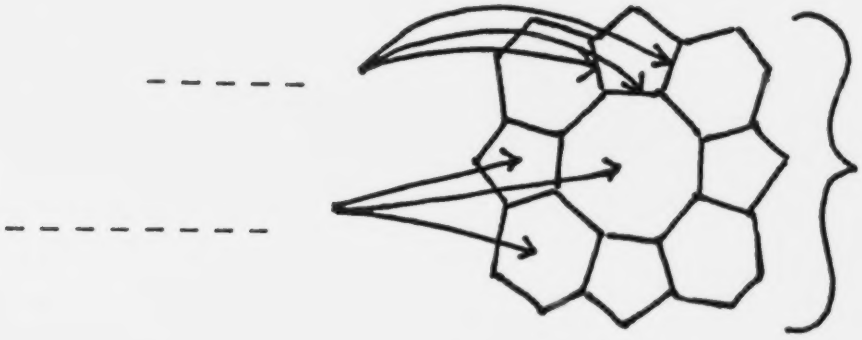
BONDING



Outline as many different patterns you can find in the diagram above using a different color for each. How many can you find?_____

Each different colored shape represents a compound (remember, a compound is made up of elements). Each seperate unit within each shape represents the elements. The lines seperating each unit within a shape are the bonds holding the compound together. Bonds are the forces which hold together the elements that form compounds.

Example:



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ROCK CYCLE

CHARACTERISTICS

Observational skills is not only important for all sciences, but also in everyday life. This unit uses rocks and minerals as hands on activities to learn how to observe and record what students see. In the lower primary activities should be centered on observing to bring out fine points. Rocks and minerals are perfect because they are all around. Try and get a class set of various types of rocks and minerals and get the children to describe what they have. In the upper primary learning how to record observations becomes important.

LOWER PRIMARY

A. Observational skills. Activities should center on: (1) Children looking at the world around oneself (not necessarily rocks and minerals) (2) Using various types of senses to figure out items (not necessarily rocks and minerals). (3) Recognizing that each rocks and minerals have special characteristics.

B. Geometric Shapes using minerals. (1) What different kinds of shapes do minerals have? (2) Three dimensional versus two dimensional paper representation.

UPPER PRIMARY

C. Identifying key characteristics. (1) What are key characteristics? (2) What are the differences between rocks and minerals? (3) What are the key characteristics of minerals? (4) What are the key characteristics of rocks?

name _____

Teacher's Sheet

Coloring exercise.
Discussion on what children are wearing, what children are doing, how do you know they are in the garden.

Teacher's Sheet

THIS IS PRIMARILY A COLOR ASSOCIATION EXERCISE USING THE MINERALS IN YOUR KIT.

name

black — MICA

white — QUARTZ

green — SERPENTINITE

red — CHERT

gold — PYRITE

name

Black

White

Green

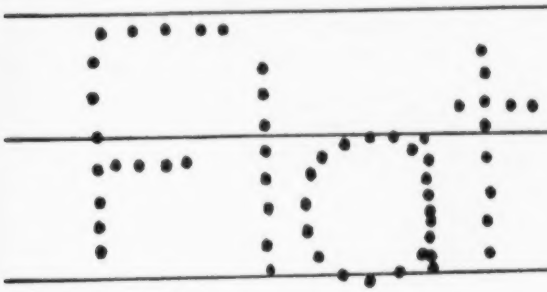
Red

Gold

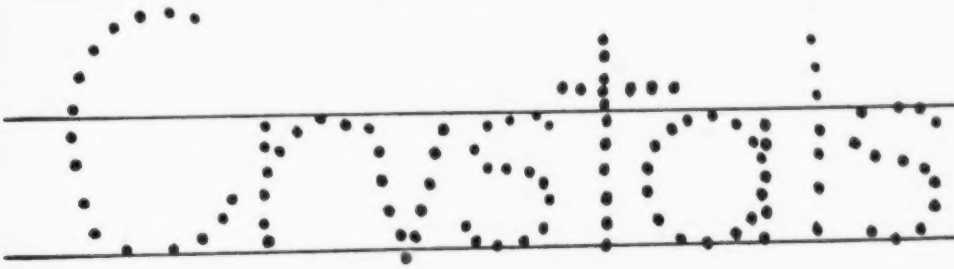
Teacher's Sheet

name

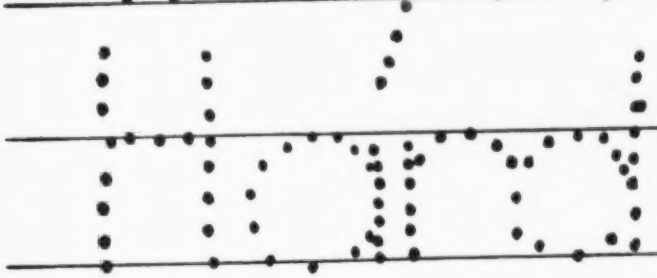
THIS EXERCISE EMPHASIZES SOME CHARACTERISTICS OF MINERALS AND ROCKS AND UTILIZES OBSERVATIONAL SKILLS.



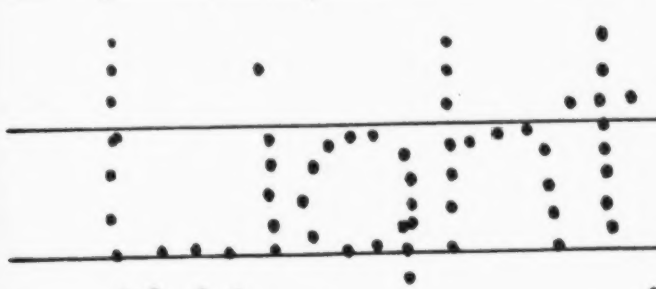
MICA



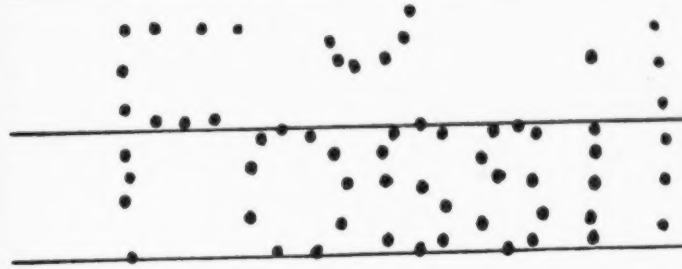
GALENA & PYRITE



QUARTZ

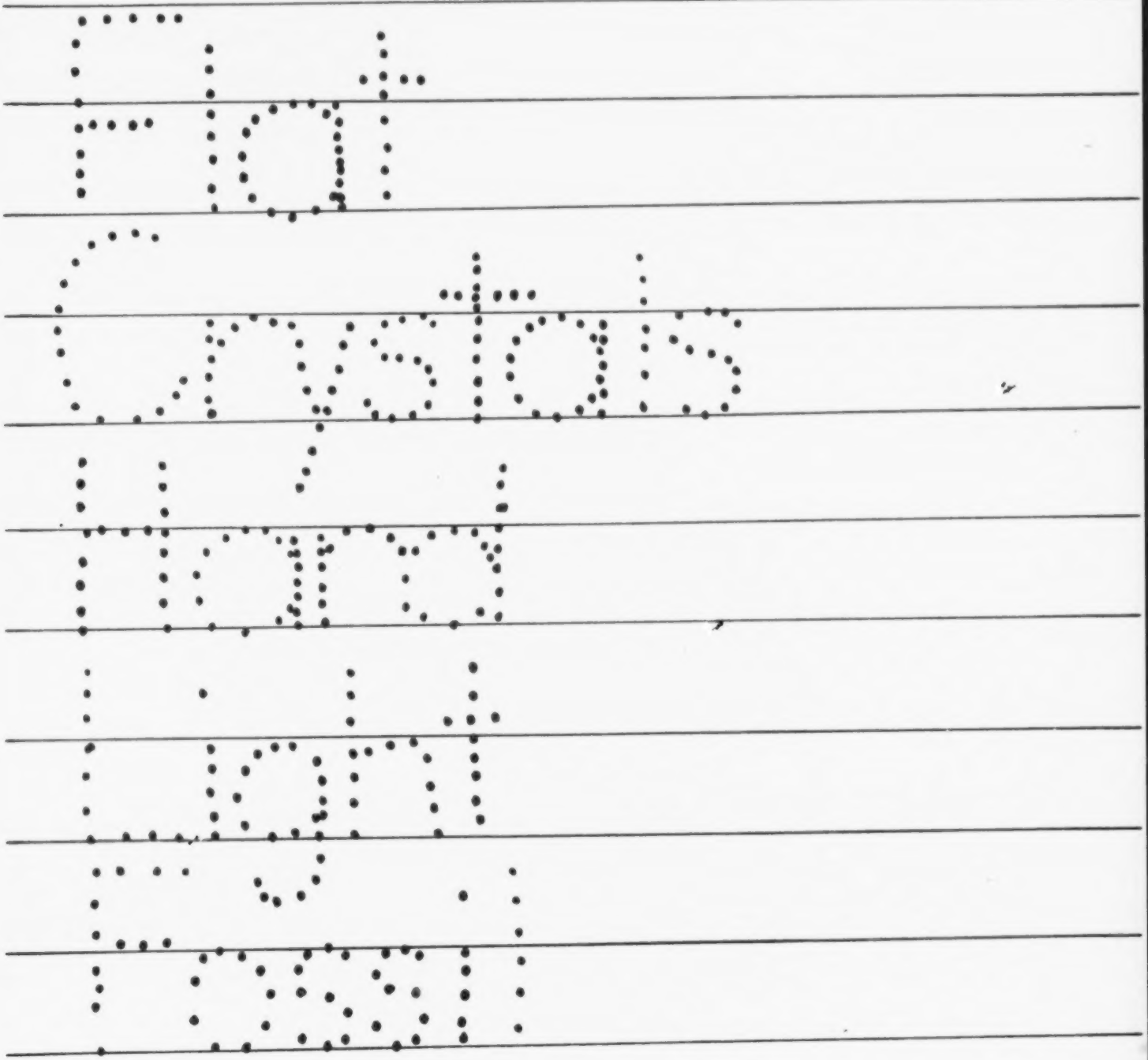


PUMICE



CLAM

name



Teacher's Sheet

Penny Quiz

THIS IS AN OBSERVATIONAL SKILLS EXERCISE UTILIZING A PENNY THAT THE CHILDREN STUDY FOR TWO OR THREE MINUTES. THEN THE FOLLOWING QUESTIONS ARE ASKED.

1. WHO IS THE MAN ON THE PENNY ?

2. DRAW WHAT YOU SEE ON THE OTHER SIDE AND TELL ME WHAT IT IS?

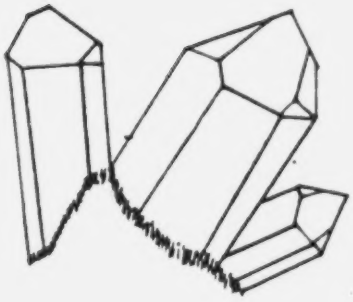
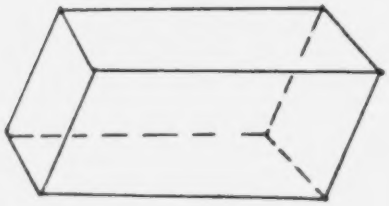
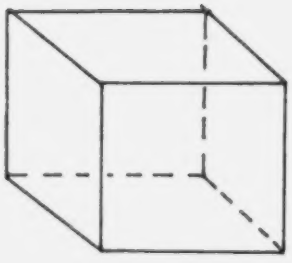
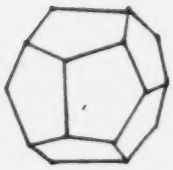
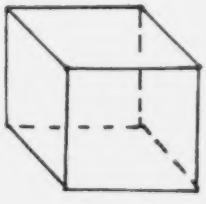
3. WHICH SIDE OF THE PENNY HAS ARABIC NUMBERS AND LETTERS?

4) WHICH SIDE HAS ONLY LETTERS?

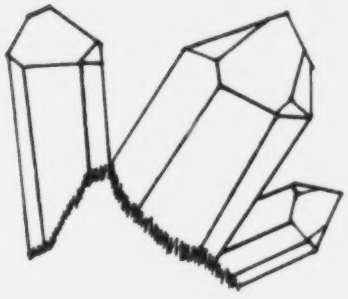
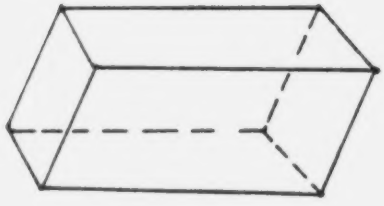
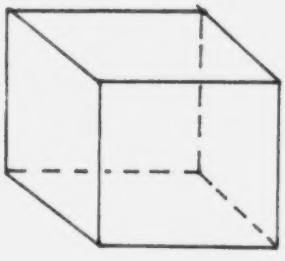
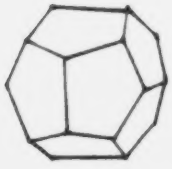
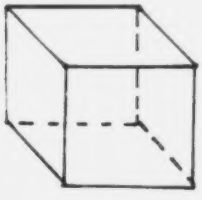
5) WHAT KIND OF TIE IS MR. LINCOLN WEARING? BOW OR LONG

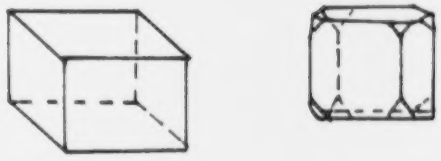
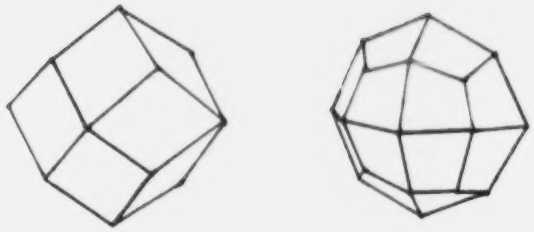
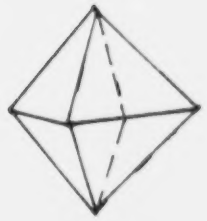
Teacher's Sheet - Reinforce for students that these are ideal crystal shapes. Sometimes a crystal can not grow in these patterns because there is no room to grow.

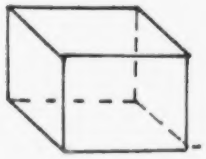
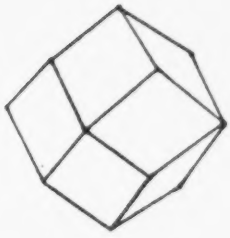
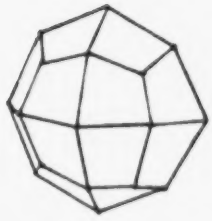
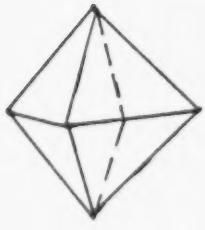
NAME_____

MINERAL NAME	CRYSTAL SHAPE	COMMENTS/DESCRIPTION
QUARTZ		THE SHAPE IS A PRISM AND IT HAS SIX SIDES.
CALCITE		THE SHAPE IS A 3D PARALLELOGRAM
HALITE		THE SHAPE IS CUBIC WITH SIX FLAT SIDES
PYRITE	 a  b	A) IS A PYRITOHEDRON CHARACTERIZED BY THE FIVE SIDED FACES. B) CUBIC SHAPE

NAME_____

MINERAL NAME	CRYSTAL SHAPE	COMMENTS/DESCRIPTION
QUARTZ		
CALCITE		
HALITE		
PYRITE	 a  b	

MINERAL NAME	CRYSTAL SHAPE	COMMENTS/DESCRIPTION
GALENA		
GARNET		
DIAMOND		

MINERAL NAME	CRYSTAL SHAPE	COMMENTS/DESCRIPTION
GALENA	 A B	WHAT IS THE DIFFERENCE BETWEEN THE TWO SHAPES AND HOW MANY MORE SIDES DOES THE SECOND SHAPE HAVE?
GARNET	 A  B	A) IS A DODECAHEDRON THAT HAS TWELVE SIDES B) IS A TRAPEZOHEDRON THAT HAS 24 SIDES.
DIAMOND		THIS SHAPE IS A HEXTETRAHEDRON (Dipyramid) AND IT HAS EIGHT SIDES.

name teacher

Key Characteristics

How do we recognize other people? How do we tell our friends apart from each other? What things about us make us each special and different from other people?

Name some identifying characteristics of people.

male/female
height
weight
skin color/ complexion
hair (length, color, curly)
eyes (color, size, shape)
birthmarks/ scars
fingerprints
voice
age/birthdate
facial features
many others

NOTES: Emphasize physical characteristics, not personality traits or actions. Note things that can change easily & things that don't. e.g. it's easy to cut & curl your hair, but you can't change the color of your eyes. Some characteristics are good for recognizing some people & not others. e.g. height is good for adults, but not kids who are still growing. Look for unusual things. Many people have brown hair & brown eyes. How do we tell them all apart? How can we tell apart identical twins? How do criminals try to disguise themselves? How do police identify them? What's an I.D. card? What information does it have on it? Emphasize all senses. Can we recognize people with our eyes closed?

How do we tell minerals apart from each other? What characteristics do we look for in order to recognize a mineral and tell it apart from other minerals? Name some characteristics we use to identify minerals.

crystal shape
habit (how crystals grow together)
color
streak (or powder) color
hardness
luster (shine)
cleavage (breaks along definite plane surfaces)
specific gravity/density
feel
magnetism
fizz in hydrochloric acid
optical properties
others

NOTES: Do we use the same characteristics to identify minerals as we do to identify people?

name _____

Key Characteristics

How do we recognize other people? How do we tell our friends apart from each other? What things about us make us each special and different from other people?

Name some identifying characteristics of people.

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

How do we tell minerals apart from each other? What characteristics do we look for in order to recognize a mineral and tell it apart from other minerals? Name some characteristics we use to identify minerals.

_____ _____

_____ _____

_____ _____

_____ _____

name teacher

Rocks and Minerals

This sheet of questions should be given to students to help guide their thoughts. It is meant to accompany or precede the exercise in which students pick out the minerals in a piece of granite.

What are rocks made of ?

Pick up a rock and look at it. What do you see ?

Is it made of all one thing ? Or, are rocks made of different things put together ?

What are all those spots and dots on the rock ? Are they just on the outside of the rock ? Or, would it look the same if we broke it open ?

All the different things you can see in your rock are minerals.

Each of the spots is a crystal of a mineral.

ROCKS ARE MADE OF MINERALS.

name _____

Rocks and Minerals

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Each of the spots is a crystal of a mineral.

ROCKS ARE MADE OF MINERALS.

name teacher

Perhaps have students do bottom half of page first. Then,a drawing will be more accurate, and easier for them to do. OR, Have students do two drawings: one before, then one after looking carefully and picking out the minerals.

All kids should be able to pick out and describe at least 2 minerals (light and dark colored ones). Most students should see 3 or 4 minerals. Some students will see 5 or 6 (some correct, some not). Read the mineral descriptions below, and see if you can match the descriptions with minerals in the rock. Some students will need coaching to get on the right track, but most catch on quickly. Do NOT worry about the names of the minerals. The descriptions are the most important part. This is an exercise in observation. It is not important that the students come up with the exact correct answers.

Draw a picture of your rock.

This kind of rock is called granite. How many different minerals can you find in your piece of granite?

Look at the colors, shapes, textures, and other chacacteristics of the minerals. Describe each of the different minerals in your rock.

1. QUARTZ - irregular shapes, gray to transparent, hard, glassy looking, conchoidal fracture.
2. BIOTITE MICA - round, flat grains, platy, flakes apart, soft, black, shiny.
3. HORNBLENDE - black to greenish-black, dull, rectangular or rod-shaped crystals, sometimes striated (small lengthwise grooves).
4. FELDSPAR (2 types) - white, gray, or pinkish, squarish corners, hard, has cleavage surfaces (smooth, flat surface that reflects light).

These are the most important & abundant minerals in an average piece of granite. You and your students may find other, accessory minerals, or not all of these.

name _____

Draw a picture of your rock.

This kind of rock is called granite. How many different minerals can you find in your piece of granite?

Look at the colors, shapes, textures, and other chacacteristics of the minerals. Describe each of the different minerals in your rock.

1. _____

_____

2. _____

_____

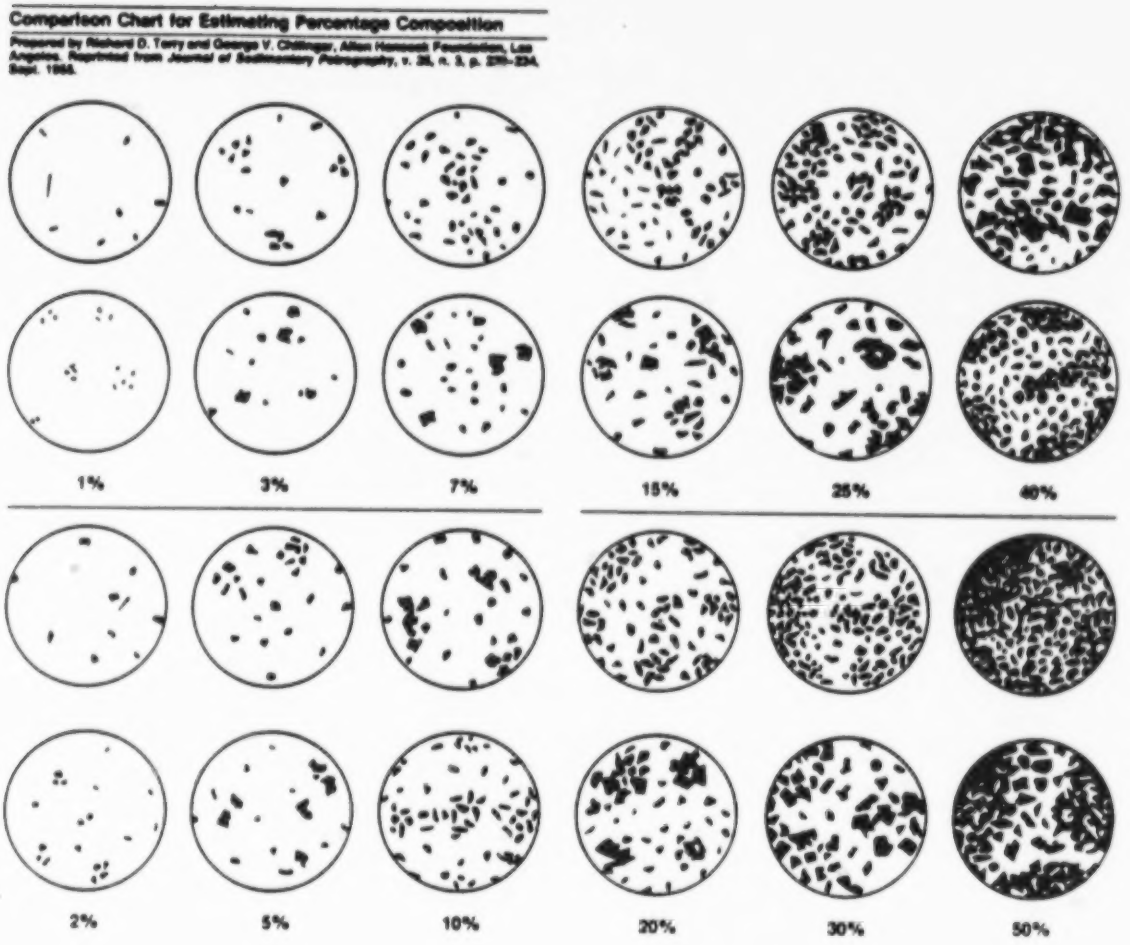
3. _____

_____

4. _____

_____

Percentage Composition



Use this chart to estimate percentage composition of sand samples (or of any rock). Compare your sand sample, or rock, to the circles in the chart. The black portion of each circle is the indicated percentage of the total area of the circle. There are two examples given for each percentage.

SAND

Use these questions as an outline to guide your class through exercises using different samples of beach sand. These activities can range from simple exercises in observation for the youngest children, to exercises illustrating concepts of erosion, weathering, sedimentation, the formation of sedimentary rocks, etc., for older students.

****

WHAT IS SAND MADE OF?

Is all sand the same?

Where can we find sand? (beaches, deserts, rivers, bays, dunes, etc. - everywhere)

Is all beach sand the same? Do different beaches have different kinds of sand?

** Divide class in small groups and give a different sample of sand to each group. Have students use only a small pinch of sand and spread it out on a sheet of millimeter-ruled graph paper. Have each group study and do a report (written or oral) on their sand using the following questions, charts, and diagrams as guides:

What color is the sand? Is it many colors or all one color?

Look at each grain of sand.

Is the sand composed of all one thing, or a mixture of many things?

What kinds of different grains are there?

Are all grains the same COLOR, SIZE, SMOOTHNESS, ROUNDNESS ?

Have student groups get together and report to the class about their sand.

OR, Have student groups trade sand samples and repeat the exercise. Then, COMPARE.

How are the sand samples the same? different?

Are the different sands composed of the same things, or of different things?

If composed of the same things, how are they different?
- -different size particles
- -different amounts of same things (% composition)
- -different textures of particles (roundness, angularity)

If the sands are composed of different things, what is it composed of? Is sand all one thing, or a mixture of many items?

What is in sand?
- -rock fragments
- -organic matter (plants, shells, etc.)
- -man-made items (glass, plastic, litter)
- -other?

If sands are of different compositions, how are they the same?

ACTIVITIES (to analyze sand)

1. separate magnetic and non-magnetic minerals

2. size sort with screens (window screens, strainers, etc. with different size holes)

3. pan for heavy minerals (pie plate)

4. examine it with a hand-lens, looking for:
   -color
   -size
   -sorting
   -roundness/angularity
   -shape of grains/shpericity
   -composition

Use these questions and the attached charts and diagrams as a guide:

SORTING

How big are the grains of sand?
Are they all the same size?
How big is the largest grain of sand? How big is the smallest? (size ranges)
What is the average size of most of the sand grains?

COMPOSITION

Is some sand made of all one thing?
If it is a mixture, how many different things are in it?
Is some of the sand little broken pieces of rocks?
Are the fragments all from the same kind of rock?
Is some of the sand from living things? a lot, or a little?
Can some sand be made only of rock fragments, or only of shell fragments?
Use the attached charts to help estimate what per cent of the total composition the different things in the sand are.

ROUNDNESS/ANGULARITY

How smooth and rounded are the grains?
Or are they rough, jagged, and angular?

SPHERICITY

What shape are the grains of sand? spheres, rods, discs, blob shapes?

Other related activity: Set up a rock tumbler in class to show processes and effects of erosion, abrasion, etc.

SAND (continued)

Now that we know what sand is made of, and that sands can be very different in many ways, we can go on to some other exercises and answer other questions.

****

HOW IS SAND MADE? Where does it come from?

Where do each of the different components of sand come from?

1. man-made objects (glass, plastic, litter, etc.)
   - How do these become part of the beach?
   - Are they really part of the sand? Why/Why not?
2. organic matter (wood, plants, shells, etc.)
   - Where do thes come from?
   - How do these get made into the sand?
3. rock fragments
   - How does the rock get broken up?
   - How do the grains of sand get smooth and round?
   - Why is some sand very coarse (big grains)?
   - Why is some sand very fine-grained?

How did the sand get on the beach? (or wherever it was found)

- -from eroding sea-cliffs at the beach?
- -brought in by a river emptying into sea at the beach?
- -brought up by waves from the water?
- -washed down from a neighboring beach by currents?
- -blown in by the wind?
- -other sources?

* This question is helpful to the children when writing about their sand grain's "life story". It is also an excellent question to ask on a field trip where students can actually observe these things.

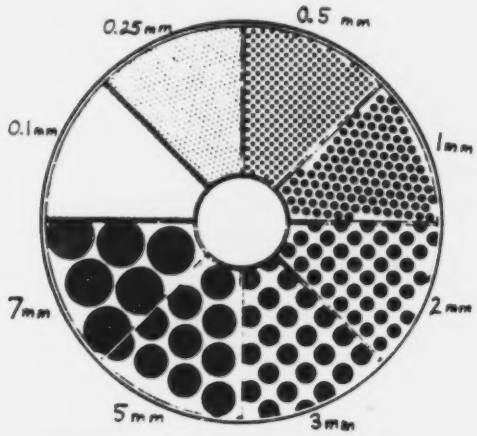
* The questions on this page are a good introduction to the ROCK CYCLE and concepts of: Weathering, Erosion, Transportation, Sedimentation } WETS

Grain Size

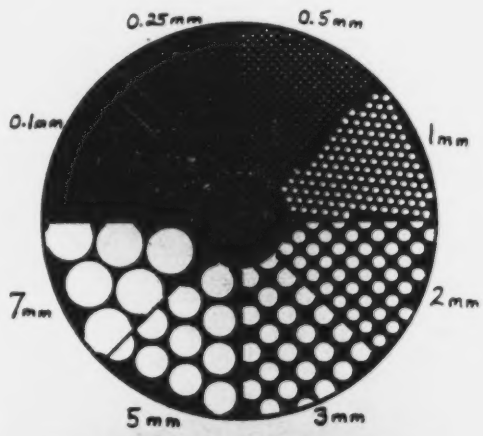
Graph for Determining the Size of Sedimentary Particles

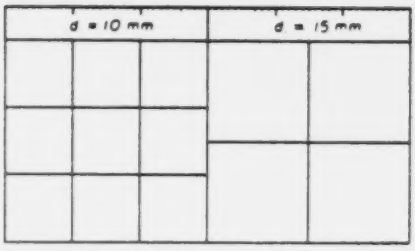
by the Data Sheet Committee, aided by George V. Chilingar

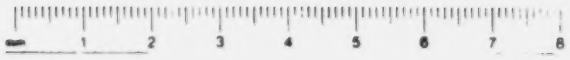
DARK PARTICLES



LIGHT PARTICLES







Place sand grains or rock particles in the central part of the circles. Use the circle on the left for dark colored particles, and the circle on the right for light colored particles. Compare the size of the particles with those on the graph with the aid of a magnifying glass. Record the corresponding measurement. Use the boxes below the circles for larger particles. For samples with particles of varying sizes, record the most common size first.

BEST COPY AVAILABLE

CLASSIFICATION OF SEDIMENTS AND SEDIMENTARY ROCKS BY GRAIN SIZE, SORTING, AND ANGULARITY

Table 12-2. Classification of Detrital Sediments by Grain Diameter

Exact Size Limits	Approximate Inch Equivalents	Name of Loose Aggregate
>256 mm	>10 in.	Boulder gravel
64–256 mm	2.5 –10 in.	Cobble gravel
32– 64 mm	1.2 – 2.5 in.	Very coarse pebble gravel
16– 32 mm	0.6 – 1.2 in.	Coarse pebble gravel
8– 16 mm	0.3 – 0.6 in.	Medium pebble gravel
4– 8 mm	0.15 – 0.3 in.	Fine pebble gravel
2– 4 mm	0.08 – 0.15 in.	Granule (or very fine pebble) gravel
1– 2 mm	0.04 – 0.08 in.	Very coarse sand
½– 1 mm	0.02 – 0.04 in.	Coarse sand
¼– ½ mm	0.01 – 0.02 in.	Medium sand
⅛– ¼ mm	0.005 – 0.01 in.	Fine sand
1/16– ⅛ mm	0.002 – 0.005 in.	Very fine sand
1/256– 1/16 mm	0.00015– 0.002 in.	Silt
<1/256 mm	<0.00015 in.	Clay (clay-size materials)

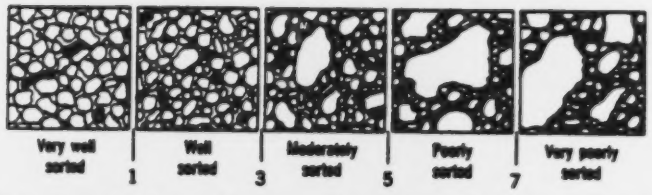


Fig. 12-1. Terms for degrees of sorting. The numbers indicate the number of size-classes included by the great bulk (80 percent) of the material. The drawings represent sandstones as seen with a hand lens. Silt and clay-size materials are shown diagrammatically by the fine stipple.

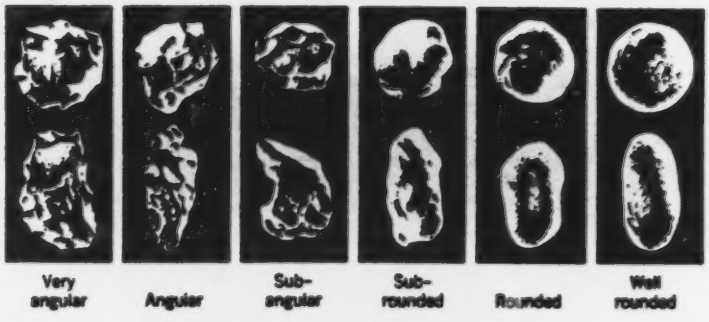


Fig. 12-2. Terms for degree of rounding of grains as seen with a hand lens. After Powers, M. C., 1953, *Journal of Sedimentary Petrology*, v. 23, p. 118. Courtesy of the Society of Economic Paleontologists and Mineralogists.

FROM: Compton's Manual of Field Geology, 1962, John Wiley & Sons, New York.

name teacher

Draw a picture of your grain of sand.

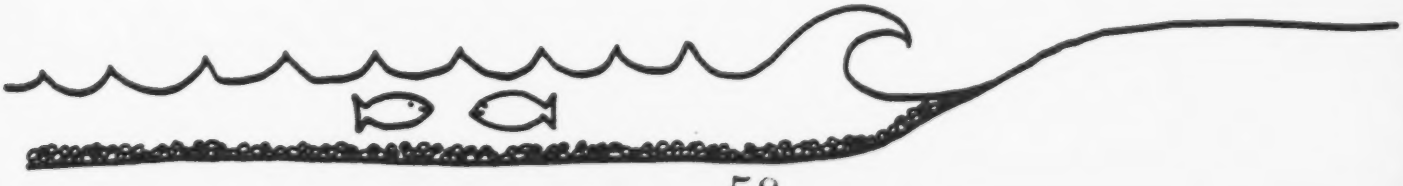
Write a story about your sand.

Instruct children to tell the "life story" of an individual grain of sand: Who were its "parents"? How was it "born"? Where was it "born"? Where did it come from? Does it have any "brothers" or "sisters"? What happened to it while "growing up"? Did it travel? change shape? change size? How did it get to be the way it is today? How did it get to be where it is today? Where was it found? - Incorporate ideas of weathering, erosion, transportation, etc.

Extend the story into the future: What will become of the grain of sand? Will it go anywhere else? Incorporate ideas of sedimentation, and formation of sedimentary rocks, etc.

Have students use another sheet of paper if necessary.

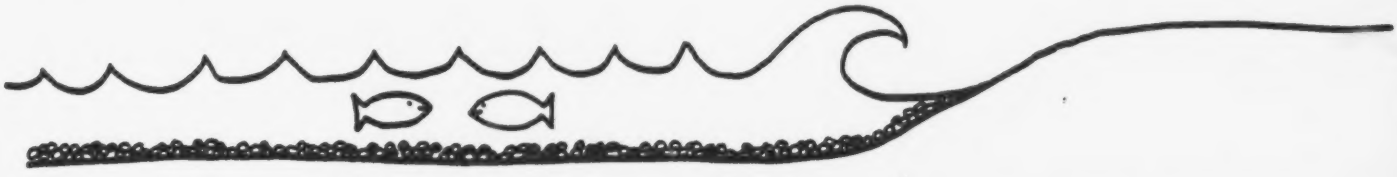
Other option: Have students write a newspaper story with headlines, etc. Students can also accompany their sands' life stories or newspaper stories with a drawing of where their sand came from.



name _____

Draw a picture of your grain of sand.

Write a story about your sand.



ROCK CYCLE

MINERALS

Minerals are the building blocks of rocks. Minerals are also important to the world economy. Some minerals such as gold and platinum can determine the wealth of a nation. Some minerals are used in various defense industries and become important to that country. Some minerals are admired because of their beauty, like diamonds and emeralds. Minerals are fundamental to our existence.

In the lower primary, students should be introduced to the beauty of minerals. That different colors and shapes make them attractive and easy to recognize. In the upper primary grades students attention should be focused on the importance of minerals and how molecules combine to make molecules.

LOWER PRIMARY

A. MINERALS ARE PRETTY - What color are minerals? What shape are minerals? How many pretty minerals can you find?

B. WHAT IS A MINERAL? - What is a crystal? Can minerals be crystals? Can crystals grow? Where minerals alive once?

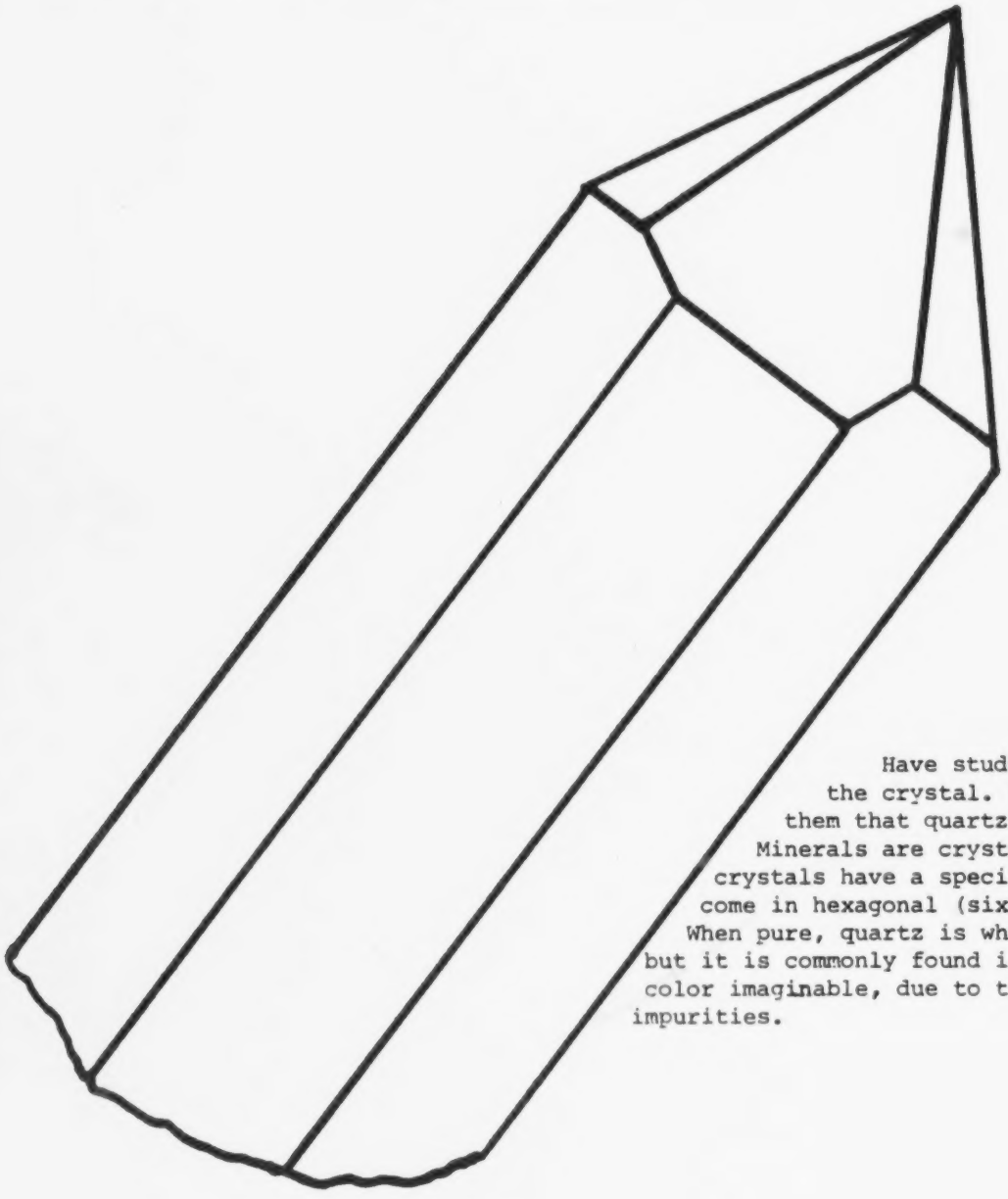
C. HOW DO YOU RECOGNIZE MINERALS? - How hard are minerals? Do all minerals look the same? Do all minerals have the same crystal shape? How do minerals break? Do all minerals have the same color?

UPPER PRIMARY

D. WHY ARE MINERALS IMPORTANT? - Where do minerals come from? Where do we use minerals? Do countries depend on minerals? What is made from minerals? Can we do without minerals?

E. HOW DO MOLECULES COMBINE TO FORM MINERALS? - Do different shapes of minerals reflect internal structure? How do molecules combine?

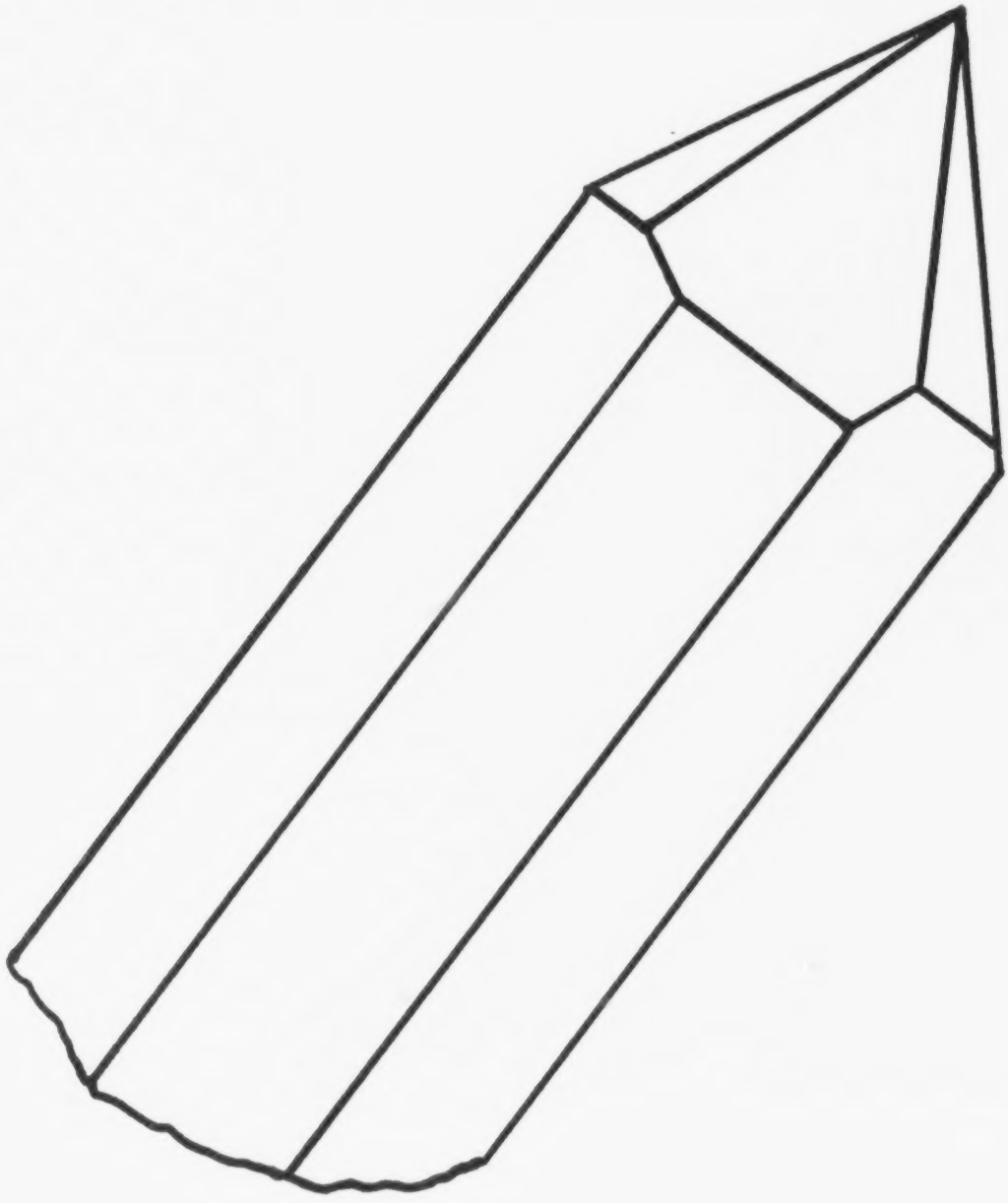
name _____ teacher _____



Have students color the crystal. Point out to them that quartz is a mineral. Minerals are crystals. Quartz crystals have a specific shape. They come in hexagonal (six-sided) prisms. When pure, quartz is white or colorless; but it is commonly found in almost any color imaginable, due to tiny amounts of impurities.

quartz

name _____



quartz

TEACHER SHEET

GROWING CRYSTAL GARDENS

RECIPE:
4 Teaspoons water
4 Teaspoons ammonia
4 Teaspoons laundry bluing
4 Teaspoons salt

Pour mixture into dish or jar, over small pieces of sponges, porous rocks or broken bricks. Add drops of food coloring. Sprinkle about 4 teaspoons of salt over the sponges or rocks. Wait about 5-6 hours (or sometimes several days) for crystals to grow.

When sponges or rocks dry out, you can get the crystals to grow some more by adding a mixture of equal parts water and ammonia, very carefully, a little at a time.

TEACHERS: Growing the crystals can illustrate to the students how crystals "grow." Emphasize that other than people and living things grow. Grow means to get larger, as these crystal gardens illustrate.

Make a mineral person

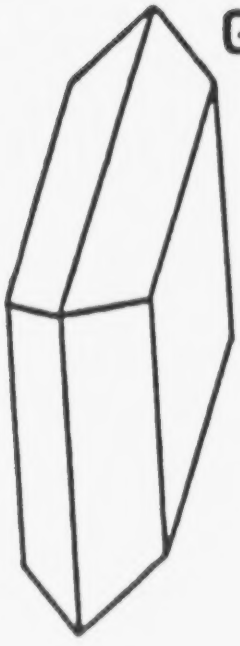
Calcite

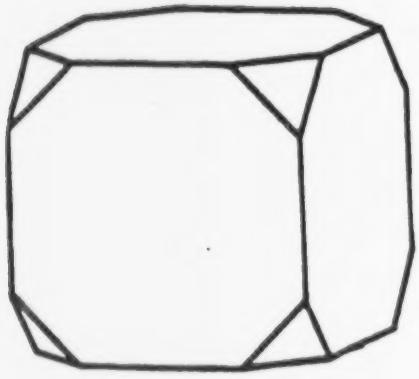
TEACHER SHEET

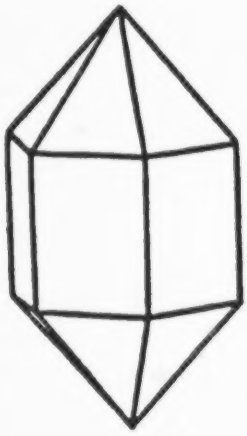
HAVE STUDENTS COLOR AND CUT OUT THESE DIFFERENT MINERAL SHAPES. HAVE STUDENTS ARRANGE THEM INTO THE SHAPE OF EITHER A MAN OR WOMAN, OR ANY OTHER ORGANISM IF YOU WISH. ONLY CONCEPT HERE FOR CHILDREN TO LEARN IS THAT MINERALS HAVE MANY SHAPES.

Pyrite

Gypsum

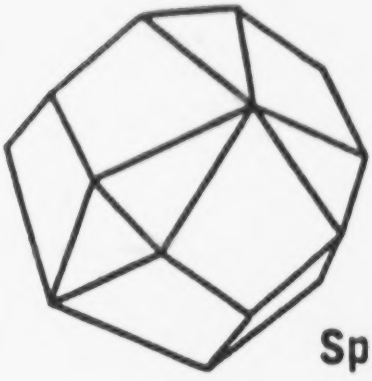


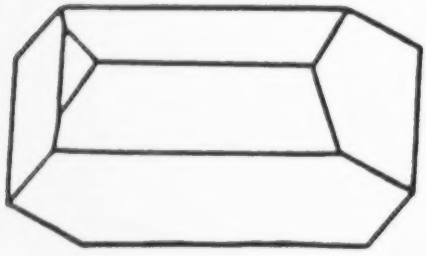




Quartz

Galena

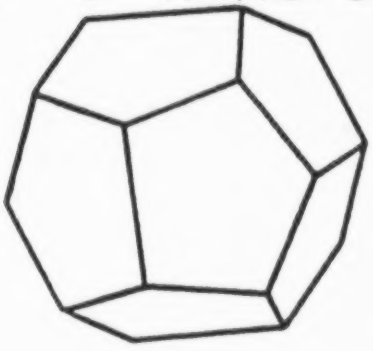




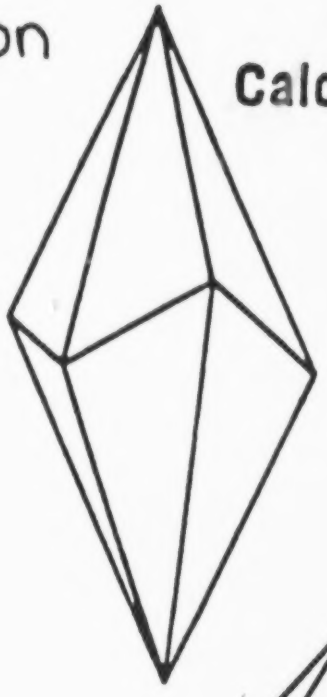
Sphalerite

Orthoclase

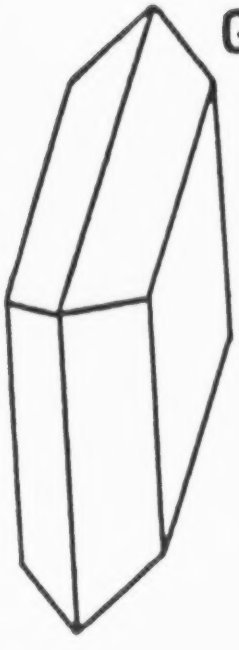
Make a mineral person



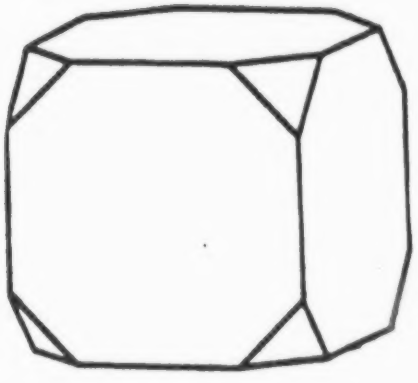
Pyrite

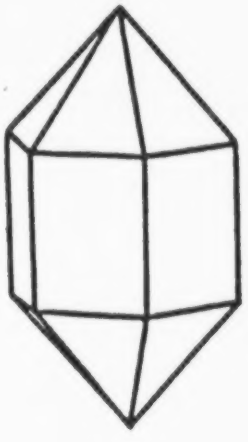


Calcite



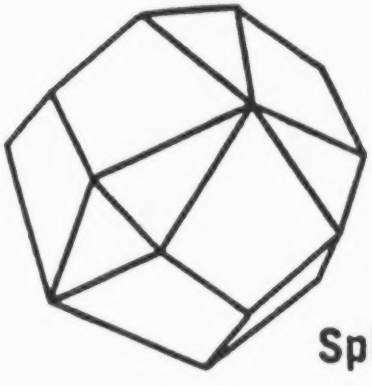
Gypsum



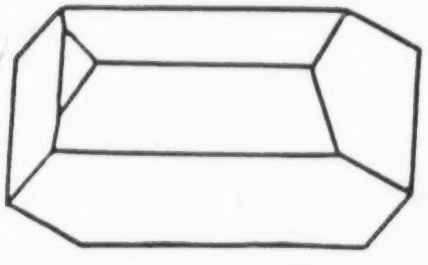


Quartz

Galena



Sphalerite



Orthoclase

TEACHER'S COPY NAME_____

EVERY MINERAL HAS A GIVEN HARDNESS THAT IS DETERMINED BY THE MOHS HARDNESS SCALE COMPOSED OF THE 10 FOLLOWING MINERALS.

1 - TALC
2 - GYPSUM
*2½ - FINGERNAIL
3 - CALCITE OR COPPER PENNY
4 - FLOURITE
5 - APATITE OR *POCKET KNIFE
5½ - WINDOW GLASS
6 - FELDSPAR OR STEEL FILE
7 - *QUARTZ
8 - TOPAZ
9 - CORUNDUM
10 - DIAMOND

****

* = most commonly used

TEST FOR THE HARDNESS OF THE FOLLOWING MINERALS IN YOUR KIT.

MINERAL	RESULTS OF SCRATCH TESTS
QUARTZ	CAN YOUR PENNY SCRATCH IT? NO CAN GYPSUM SCRATCH IT? NO CAN QUARTZ SCRATCH THE STEEL FILE? YES **********
FELDSPAR	CAN YOUR PENNY OR GYPSUM OR POCKET KNIFE SCRATCH IT? NO DOES QUARTZ SCRATCH IT? YES **********
COPPER PENNY	DOES QUARTZ OR THE POCKET KNIFE SCRATCH IT? DOES THE PENNY SCRATCH YOUR FINGERNAIL OR THE GYPSUM? **********
GALENA	CAN GYPSUM SCRATCH THE GALENA? DOES THE PENNY SCRATCH THE GALENA, TRY THE QUARTZ AND THE FELDSPAR.

NAME_____

EVERY MINERAL HAS A GIVEN HARDNESS THAT IS DETERMINED BY THE MOHS HARDNESS SCALE COMPOSED OF THE 10 FOLLOWING MINERALS.

1 - TALC
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****

TEST FOR THE HARDNESS OF THE FOLLOWING MINERALS IN YOUR KIT.

MINERAL	RESULTS OF SCRATCH TESTS
QUARTZ	
FELDSPAR	
COPPER PENNEY	
GALENA	

Teachers Copy

WHY ARE MINERALS IMPORTANT?

WHAT DOES MAN USE MINERALS FOR?

Everyday uses of minerals

MINERAL	PRODUCT/USE
QUARTZ	WATCHES
GRAPHITE	PENCILS
GYPSUM	SHEETROCK
MICA	SPARKLE IN MAKEUP
COPPER	PENNNIES
HALITE	TABLE SALT
GOLD	JEWELRY
SILVER	JEWELRY
CALCITE	CEMENT

****

The above can be used for a collective class discusssion on the use and importance of minerals.

****

HOUSE FROM A MINE

PARTS OF A HOUSE	MINERALS
FOUNDATION	LIMESTONE,CLAY,SHALE,GYPSUM
INSULATION	GLASS WOOL,SILICA,FELDSPAR,TRONA
NAILS & SCREWS	IRON ORE & ZINC
SANITARY FACILITIES	PORCELAIN & CLAY
SEWER PIPING	CLAY OR IRON PIPE
WATER PIPE	IRON ORE OR COPPER
ELECTRICAL WIRING	COPPER OR ALUMINIUM

PLUMBING	FIXTURES	BRASS OR STAINLESS STEEL (NICKLE & CHROME)
GLASS		TRONA,SILICA,FELDSPAR

HARMFUL MINERALS

MINERAL	PROBLEM
URANIUM	CAUSES CANCER
ASBESTOS	PREVIOUSLY USED AS AN INSULATOR / FOUND TO CAUSE CANCER
MERCURY	CAN CAUSE CAUSE BIRTH DEFECTS IF INGESTED VIA POISONED FISH
ARSNIC	COMMON POISON

This series of exercises is designed to emphasize the various uses of minerals. The house from a mine exercise can be done by giving the student's a picture of a house or having them draw a house and asking them to decide what minerals are used to make various parts of the house. Finally the teacher can facilitate a discussion on minerals that can be harmful.

WHY ARE MINERALS IMPORTANT?

WHAT DOES MAN USE MINERALS FOR?

Everyday uses of minerals

MINERAL	PRODUCT/USE
QUARTZ	
GRAPHITE	
GYPSUM	
MICA	
COPPER	
HALITE	
GOLD	
SILVER	
CALCITE	

****

****

HOUSE FROM A MINE

PARTS OF A HOUSE	MINERALS
FOUNDATION	
INSULATION	
NAILS & SCREWS	
SANITARY FACILITIES	
SEWER PIPING	
WATER PIPE	
ELECTRICAL WIRING	

WHY ARE MINERALS IMPORTANT?

WHAT DOES MAN USE MINERALS FOR?

Everyday uses of minerals

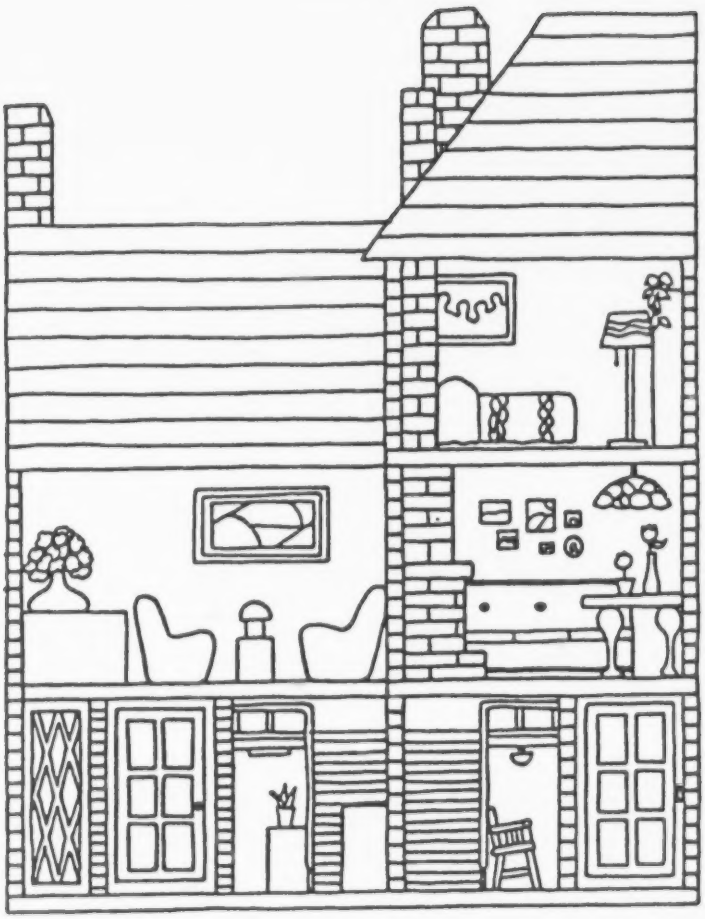
MINERAL	PRODUCT/USE
QUARTZ	
GRAPHITE	
GYPSUM	
MICA	
COPPER	
HALITE	
GOLD	
SILVER	
CALCITE	

****

****

HOUSE FROM A MINE

PARTS OF A HOUSE	MINERALS
FOUNDATION	
INSULATION	
NAILS & SCREWS	
SANITARY FACILITIES	
SEWER PIPING	
WATER PIPE	
ELECTRICAL WIRING	



Teacher Copy

This is an exercise that can be done as a collective discussion where children tell the teacher their birthstone and its color.

WHAT GEMSTONES ARE ASSOCIATED WITH EACH MONTH?

MONTH	GEM	COLOR	HARDNESS	WHERE IS IT MINED?
JAN	GARNET	Commonly red also brown, yellow&green	6.5-7.5	USSR,N.Y.
FEB	AMETHYST (QUARTZ)	purple	7	Czechoslovakia,USSR,Brazil Zambia
MAR	AQUAMARINE (BERYL)	pale greenish also blue	7.5-8	Maine,N.C.,MA.CO.
APR	DIAMOND	colorless pale yellow	10	75% Africa continent 25% USSR
MAY	EMERALD (BERYL)	deep green	7	Columbia,USSR,Zimbabwe
JUN	PEARL	white		
JUL	RUBY (CORUNDUM)	red	9	India
AUG	PERIDOT	transparent gem variety of olivine	6,5-7	Burma,St.John's Island in the Red Sea
SEP	SAPPHIRE (CORUNDUM)	blue	9	India
OCT	OPAL	colorless,white yellow,green&blue	5-6	Hungary,Mexico,New South Wales
NOV	TOPAZ	yellow,wine yellow,bluish pink	8	USSR,Saxony,Brazil
DEC	TURQUOISE	blue,bluish green,green	6	Los Cerillos Mts.near Santa Fe, Nevada & New Mexico

****

Are all of the gemstones minerals?

No pearls are not because they are created organically from living organisms with a composition of calcium carbonate and true minerals are inorganic.

Would you use a soft mineral as a gemstone?

WHAT GEMSTONES ARE ASSOCIATED WITH EACH MONTH?

MONTH	GEM	COLOR	HARDNESS	WHERE IS IT MINED?
JAN				
FEB				
MAR				
APR				
MAY				
JUN				
JUL				
AUG				
SEP				
OCT				
NOV				
DEC				

****

Are all of the gemstones minerals?

Would you use a soft mineral as a gemstone?

name teacher

Mineral Word Scramble

Unscramble the letters in the following words to come up with a list of important identifying characteristics of minerals.

yrclats hpeas	crystal shape
roocl	color
ersltu	luster
nrhasdse	hardness
itsdyne	density
avelceag	cleavage
skreat clroo	streak color
lefe	feel

Unscramble the following names of some common minerals.

zrqtau	quartz
acmi	mica
lderafps	feldspar
rtypie	pyrite
aganel	galena
eclatic	calcite

name _____

Mineral Word Scramble

Unscramble the letters in the following words to come up with a list of important identifying characteristics of minerals.

yrclats hpeas	_____ _____
roocl	_____
ersltu	_____
nrhasdse	_____
itsdyne	_____
avelceag	_____
skreat clroo	_____ _____
lefe	_____

Unscramble the following names of some common minerals.

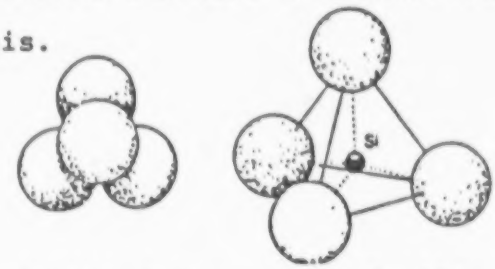
zrqtau	_____
acmi	_____
lderafps	_____
rtypie	_____
aganel	_____
eclatic	_____

Teachers Copy

HOW DO MINERALS COMBINE

The fundamental building blocks of most minerals are silica (Si) and oxygen (O).

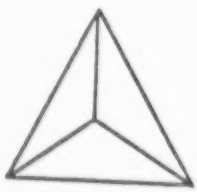
The most common molecule contains 1 silicon and 4 oxygens and looks like this.



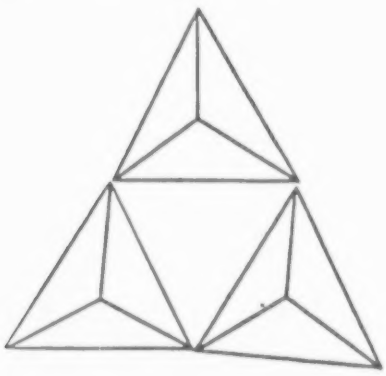
Minerals composed of Si and O are called silicates.

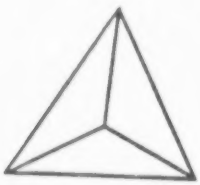
When mamy SiO4 molecules combine in different ways they create different minerals.

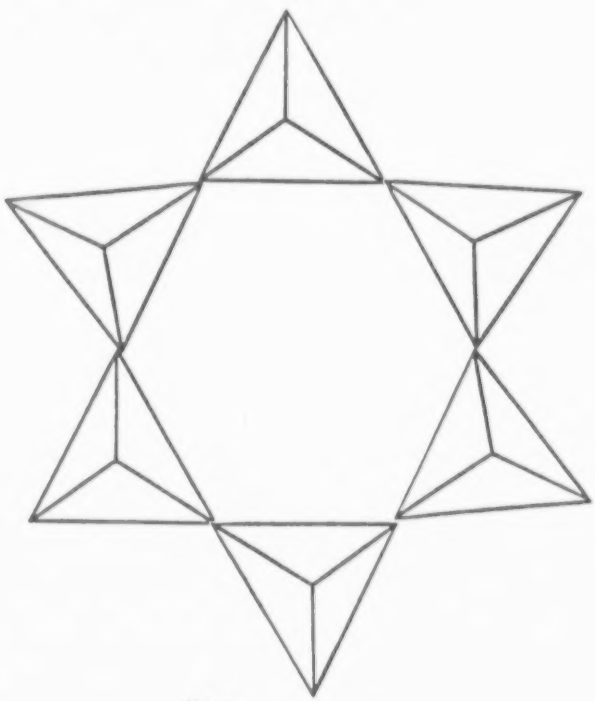
As an exercise for children have them draw 15 to 20 SiO4 molecules connected in any way they wish using this shape.



Here are some potential combinations.

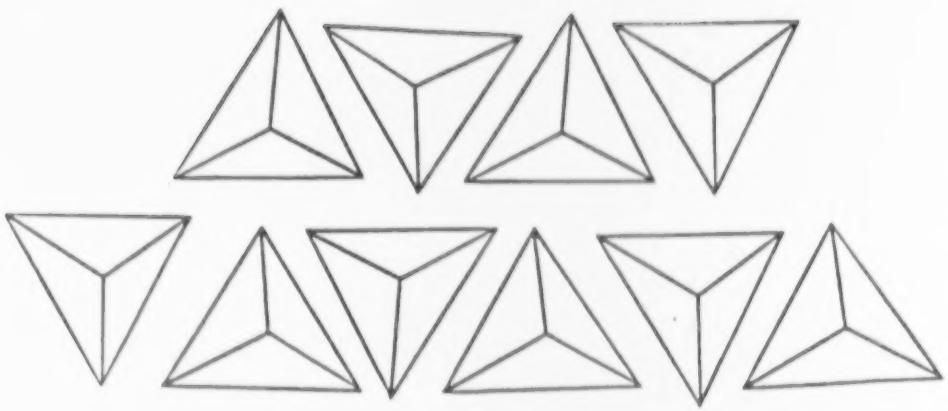




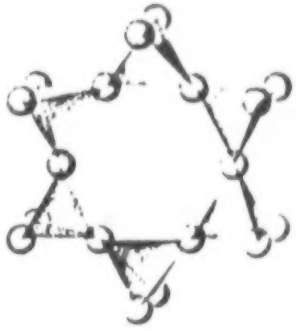
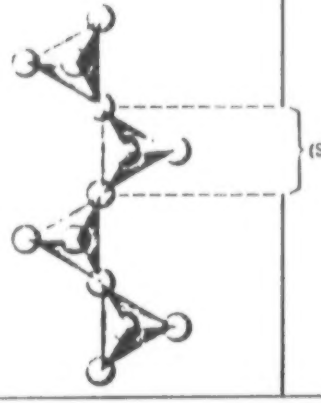


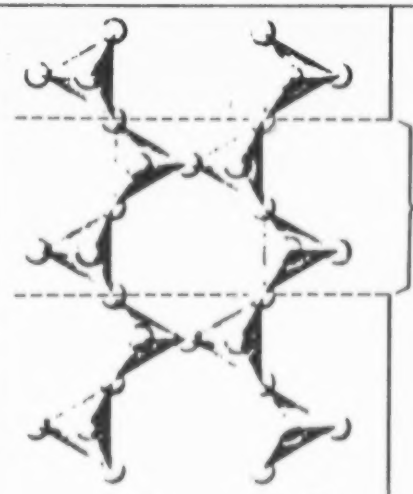
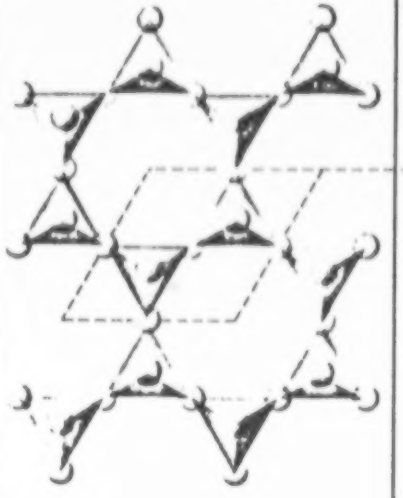
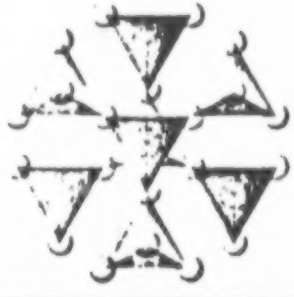
CREATE YOUR OWN MINERAL

Cut out and combine mineral building SiO_4 molecules. Draw more molecules if you need them.



BEST COPY AVAILABLE

Class	Arrangement of SiO_4 tetrahedra (central Si^{4+} not shown)	Unit composition	Mineral example
Nesosilicates		$(SiO_4)^{-4}$	Olivine, $(Mg, Fe)SiO_4$
Sorosilicates		$(Si_2O_7)^{-6}$	Hemimorphite, $Zn_4Si_2O_7(OH)\cdot H_2O$
Cyclosilicates		$(Si_6O_{18})^{-12}$	Beryl, $Be_3Al_2Si_6O_{18}$
Inosilicates (single chain)		$(SiO_3)^{-2}$	Pyroxene e.g. Enstatite, $MgSiO_3$

Inosilicates (double chain)		$(Si_4O_{11})^{-6}$	Amphibole e.g. Anthophyllite, $Mg_7Si_8O_{22}(OH)_2$
Phyllosilicates		$(Si_2O_5)^{-2}$	Mica e.g. Phlogopite, $KMg_3(AlSi_3O_{10})(OH)_2$
Tectosilicates		$(SiO_2)^0$	High cristobalite, SiO_2

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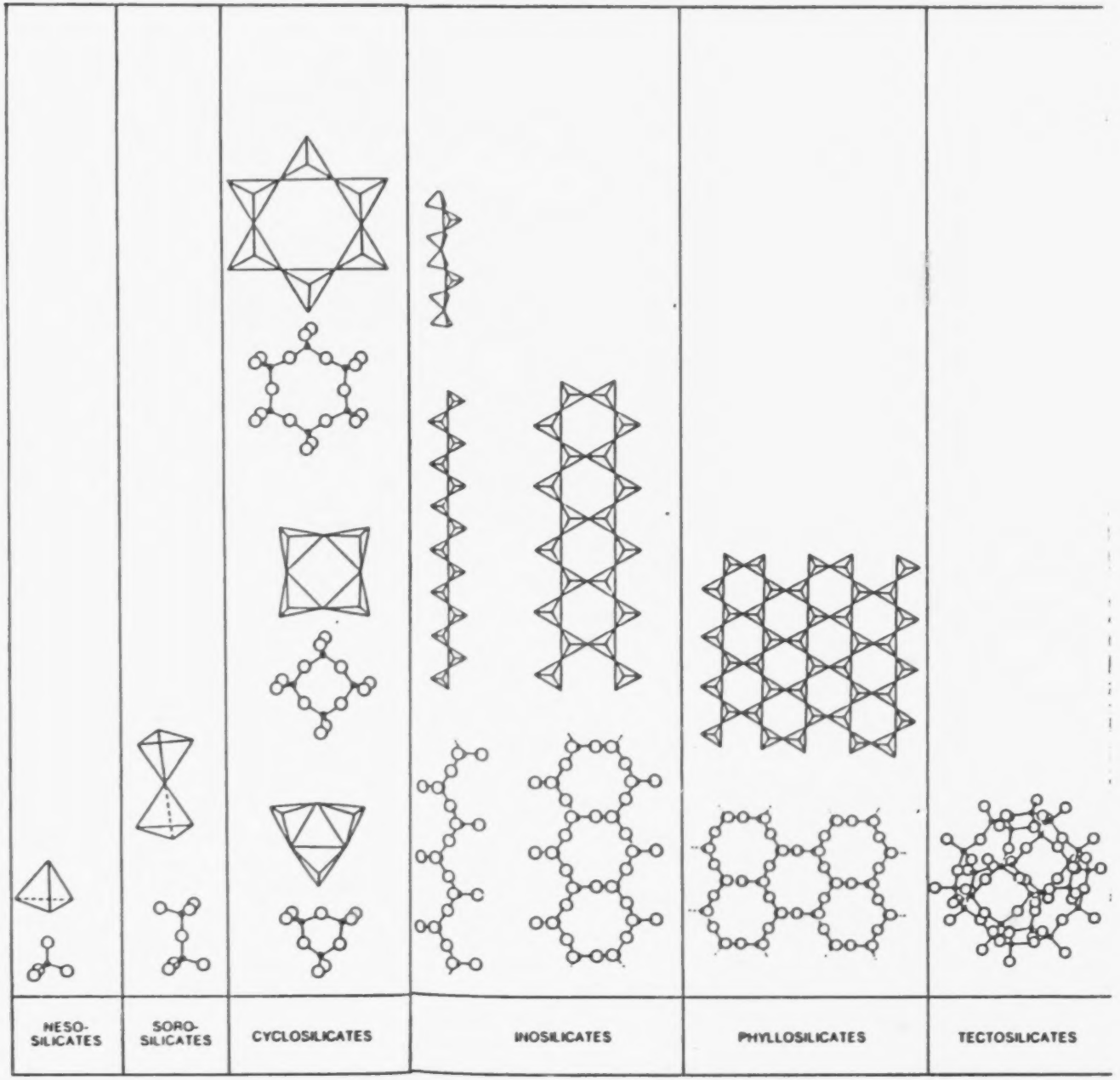


The structure of silicates. The centers of the atoms (black = silicon or aluminum, white = oxygen) and the tetrahedral coordinating polyhedra are shown here. In the nesosilicates the tetrahedron is isolated. In the sorosilicates two of these tetrahedra are linked by a vertex; in the cyclosilicates three, four or six of these form a ring. Because they are all linked by vertices, in the inosilicates there are chains with tetrahedra linked by two opposite vertices (a single chain is characteristic of the pyroxene family and a band of two facing chains is typical of the amphibole family); in the phyllosilicates tetrahedra sharing three vertices form exact or nearly hexagonal plane lattices; in the tectosilicates the tetrahedra share all four of the vertices.

ROCK CYCLE

ROCKS

Rocks are very important to the economy of a nation. Although mining of rocks is not a glamorous trade it does help countries to develop into industrialized nations. For instance, the ingredients in cement include different types of rocks like conglomerate, sand, clays and lime. What would a city be without cement? Roadways need tar and gravel, pool filters need diatomite, gardens use rocks as ornamental stones like scoria, basalt, limestone, tuff, etc. The list for uses of different types of rocks is very long. Students should learn not only why rocks are here, but why they are important to a country's economy.

LOWER PRIMARY

Students should start observing the rocks that are around their world. If you are not in a mountainous area there are still many places to identify rocks - from building stones to ornamental stones. The main concepts that should be emphasized in these grades are the connection that broken rocks plus organic matter create soil. Concepts of erosion (breaking down) helps this creation. The second concept is that there are three different types of rocks created by melting (igneous), erosion (sedimentary) and high pressure and temperature (metamorphic). Subjects that should be covered include:

A. We live on rocks - (1) Is the world made of rocks? (2) What is soil? (3) Why is soil important?

B. What is a rock? - (1) What different types of rocks are there? (2) Where are these types of rocks formed? (3) What are rocks made of?

UPPER PRIMARY

The main concepts that student should learn is what makes the three different types of rocks different and what clues can be learned about how the rocks were formed. Characteristics minerals or structurers can be introduced.

C. Description of the three different types of rocks. (1) What characteristics can help me decide what kind of rocks I have? (2) What is the rock cycle? (3) What are igneous rocks? (4) What are sedimentary rocks? (5) What are metamorphic rocks?

D. What types of environments create different types of rocks? (1) Where are rocks and minerals? (2) Are rocks and minerals found in the same place? (3) Do certain areas have more minerals that others? (4) Why are rocks and minerals important?

name

Rock

crushed

living

Material

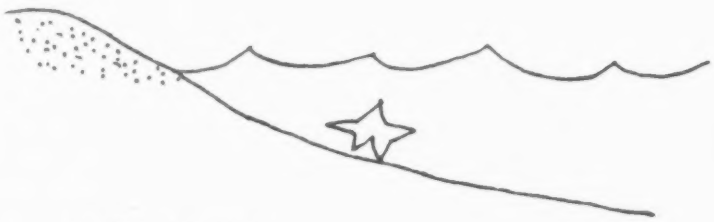
Soil is crushed rock plus living material.

Teacher's Sheet

NAME_____

MATCH THE APPROPRIATE PICTURE WITH THE CORRECT WORD.

MINERALS

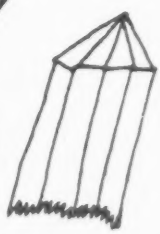


"WET ROCKS"

IGNEOUS

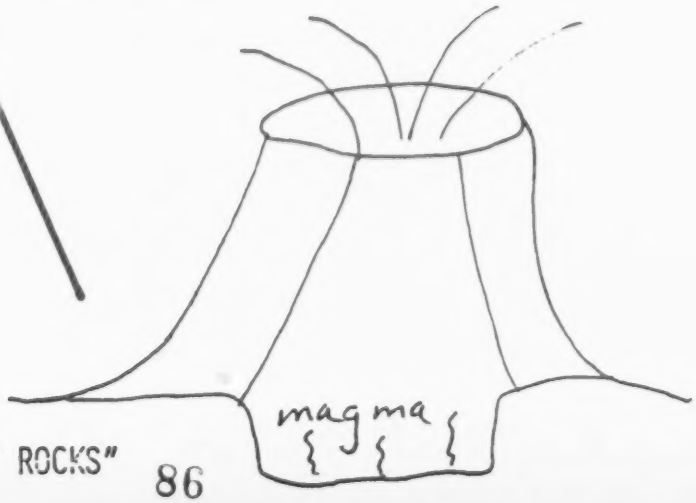
"CHANGED ROCKS"

SEDIMENTARY



WE MAKE UP ROCKS

METAMORPHIC



"HOT ROCKS"

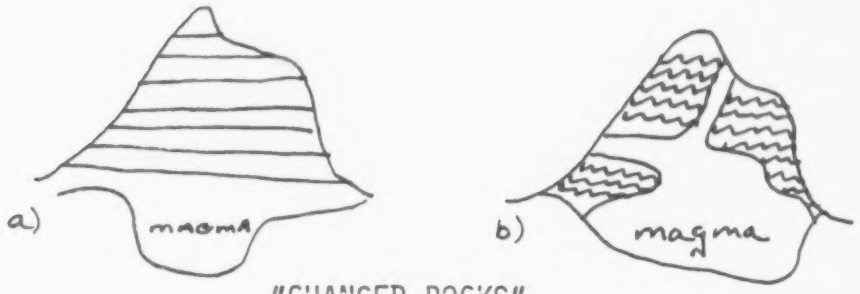
NAME_____

MATCH THE APPROPRIATE PICTURE WITH THE CORRECT WORD.

MINERALS

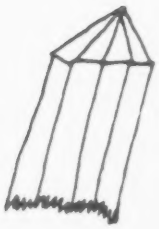
"WET ROCKS"

IGNEOUS



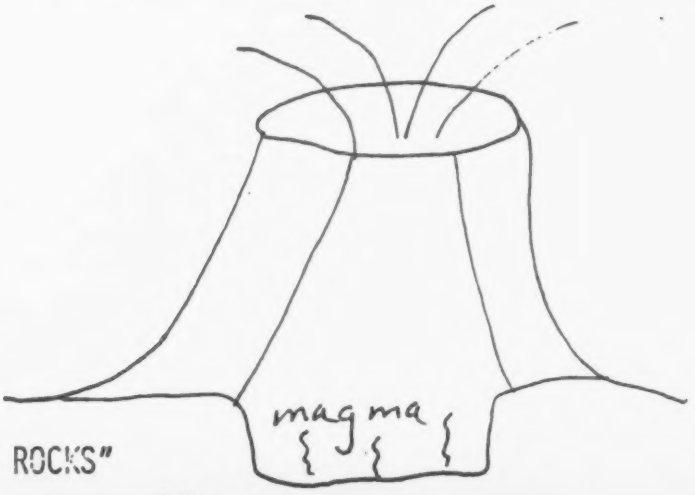
"CHANGED ROCKS"

SEDIMENTARY



WE MAKE UP ROCKS

METAMORPHIC



"HOT ROCKS"

teacher

name

Find words that will help you remember the three different types of rocks.

Igneous	ignite
	igloo
	ignescent
	ignis fatuus
	ignition
Sedimentary	sediment
Metamorphic	metamorphism
	metamorphose

name

Find words that will help you remember the three different types of rocks.

Igneous

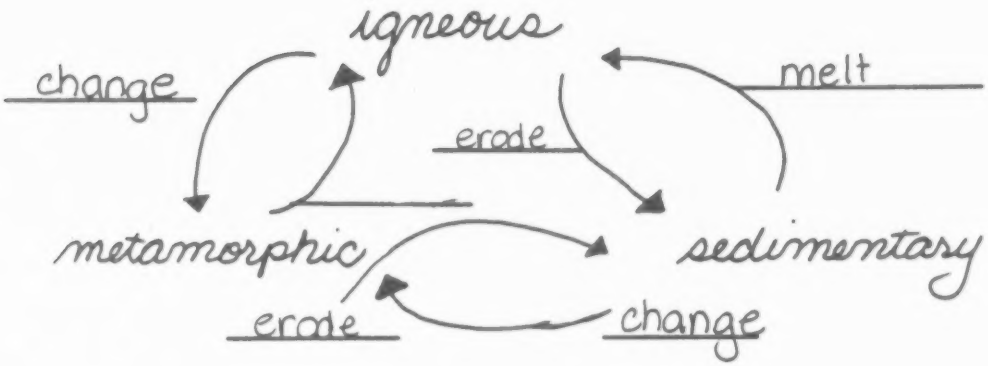
Sedimentary

Metamorphic

Rock Cycle

(can a rock cycle?)

Key words: erode
melt
change



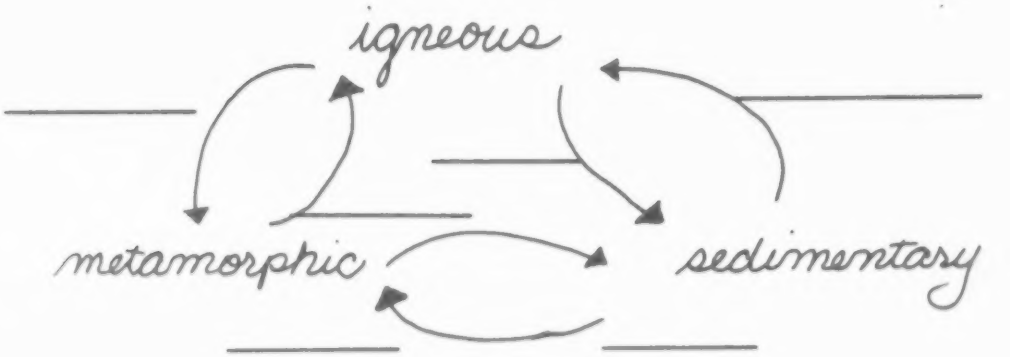
fill in the space with the correct word -
erode, melt, change

example: igneous
↑ melt
metamorphic
metamorphic becomes igneous by melting

Rock Cycle

(can a rock cycle?)

Key words: erode
melt
change



fill in the space with the correct word -
erode, melt, change

example: igneous
↑ melt
metamorphic
metamorphic becomes igneous by melting

Teacher's Sheet

DESCRIPTIVE EXERCISE THAT CAN UTILIZE ALL PREVIOUS KNOWLEDGE OF THE SUBJECT.

NAME _____

MATCH ROCK OR MINERAL WITH DESCRIPTION.

1. I AM A ROCK. I WAS ONCE MAGMA, NOW I AM MADE UP OF WHITE AND BLACK CRYSTALS. WHAT AM I?

   GRANITE

2. I AM A MINERAL. MINERS THOUGHT THEY WERE RICH WHEN THEY FOUND ME. WHAT AM I?

   PYRITE

3. I AM MADE OF SAND. NATURE HAS GLUED ME TOGETHER. WHAT KIND OF ROCK AM I?

   SANDSTONE

4. SOME PEOPLE SAY I AM A NICE ROCK. I AM A METAMORPHIC ROCK WITH LARGE DIFFERENT COLORED BANDS. WHAT AM I?

   GNEISS

5. I AM A VERY LIGHT ROCK. I FLOAT IN WATER. I WAS BORN FROM A VOLCANO. WHAT AM I?

   PUMICE

NAME _____

MATCH ROCK OR MINERAL WITH DESCRIPTION.

1. I AM A ROCK. I WAS ONCE MAGMA, NOW I AM MADE UP OF WHITE AND BLACK CRYSTALS. WHAT AM I?

_____

_____

2. I AM A MINERAL. MINERS THOUGHT THEY WERE RICH WHEN THEY FOUND ME. WHAT AM I?

_____

_____

3. I AM MADE OF SAND. NATURE HAS GLUED ME TOGETHER. WHAT KIND OF ROCK AM I?

_____

_____

4. SOME PEOPLE SAY I AM A NICE ROCK. I AM A METAMOPHIC ROCK WITH LARGE DIFFERENT COLORED BANDS. WHAT AM I?

_____

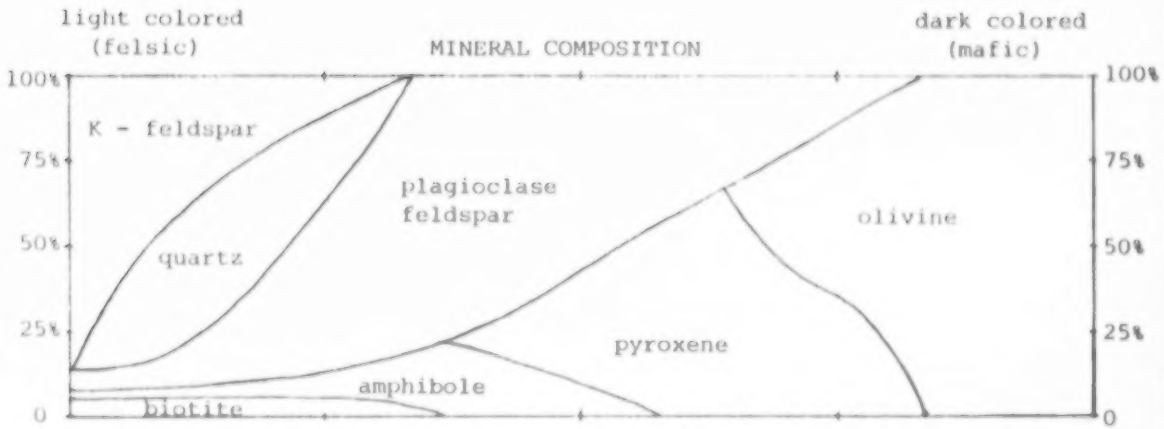
_____

5. I AM A VERY LIGHT ROCK. I FLOAT IN WATER. I WAS BORN FROM A VOLCANO. WHAT AM I?

_____

_____

IGNEOUS ROCK CLASSIFICATION



ORIGIN	TEXTURE	ROCK NAMES -			
plutonic (intrusive)	phaneritic (coarse grained)	granite	diorite	gabbro	peridotite
volcanic (extrusive)	aphanitic (fine grained)	rhyolite	andesite	basalt	
↓	glassy (no crystals)	obsidian			

NOTES: 1) Rocks with 2 distinct grain sizes: single, large crystals (phenocrysts) surrounded by a fine-grained groundmass, are called prophyritic + rock name, or rock name + porphyry.

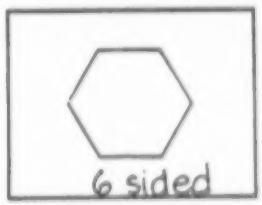
2) Pyroclastic rocks are both igneous (volcanic) and sedimentary in nature. These include tuffs, welded tuffs, consolidated ash flows, and other ignimbrites.

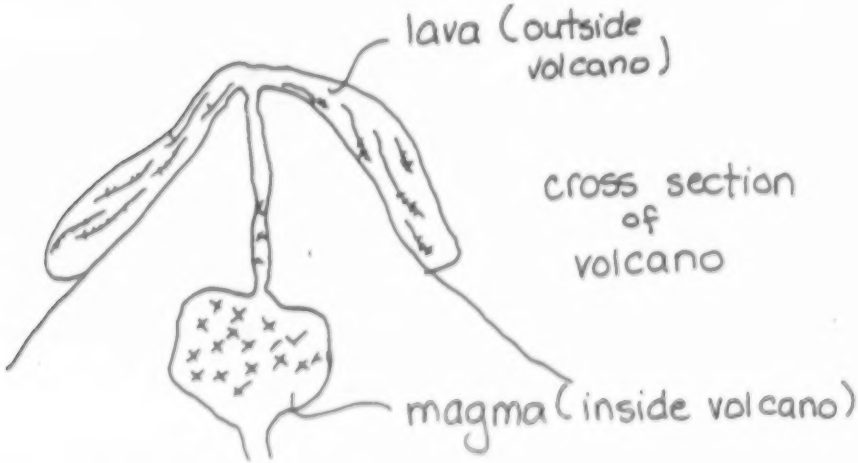
name _____ teacher _____

Crystallization

freeze

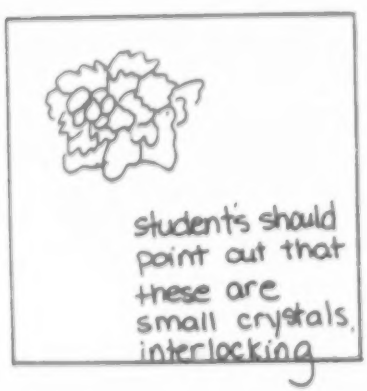
draw picture of ice crystal





draw picture of the minerals in a rock when lava cools

draw a picture of the minerals in a rock when magma cools

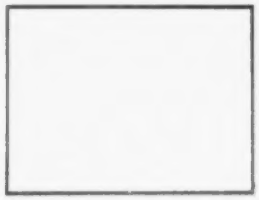


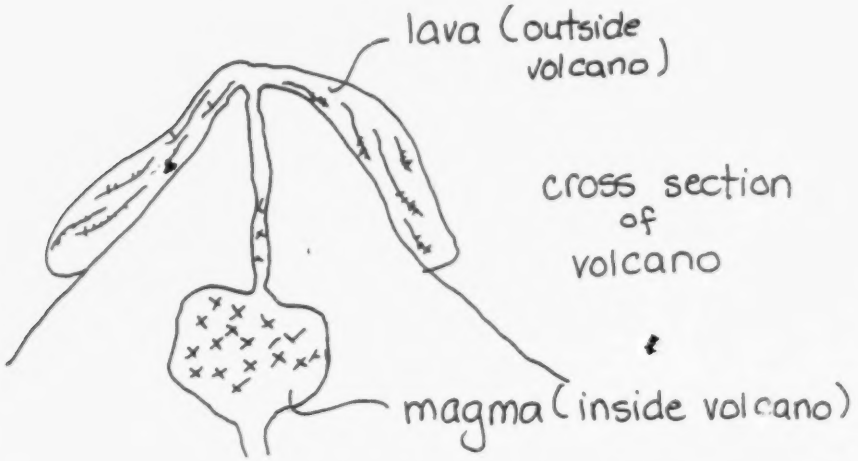
name _____

Crystallization

freeze

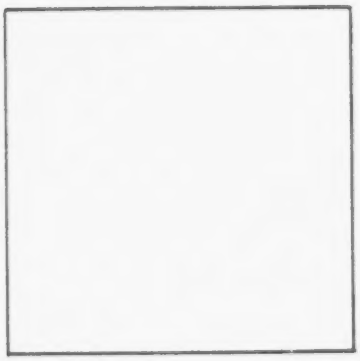
draw picture of ice crystal



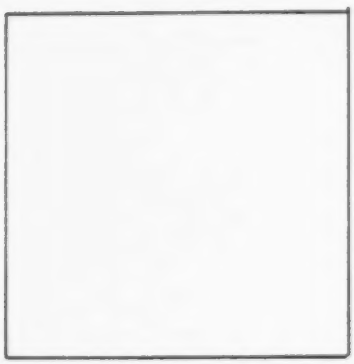


cross section of volcano

draw picture of the minerals in a rock when lava cools



draw a picture of the minerals in a rock when magma cools

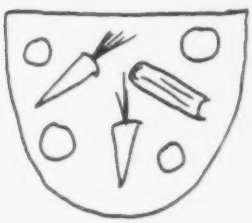


name teachers

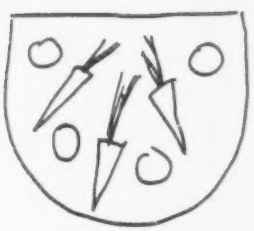
Name the SOUP

Soup is named by what is in it. Name the following bowls of soup.

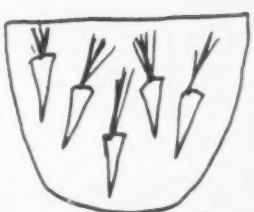
name



onion, celery, carrot



carrot, onion



carrot

= carrot = celery O = onion

Why does the soup change its name?

different ingredients are taken out

name teacher

Igneous rocks are like the carrot, onion, celery soup. Magma has all the ingredients (to make minerals). As it cools the ingredients are removed one by one. The ingredients are not onions, carrots or celery, but minerals.

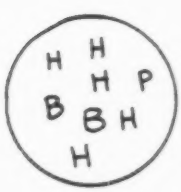
Let's simplify how minerals crystallize out of magma as follows:

order of crystallization	mineral	symbol
1	olivine	O
2	pyroxene	P
3	hornblende	H
4	biotite	B
5	feldspar	F
6	quartz	Q

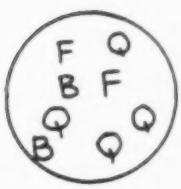
Using the symbols, name the minerals in the rocks that are drawn

name minerals

olivine, pyroxene, hornblende



hornblende, pyroxene biotite



feldspar, biotite, quartz

name _____

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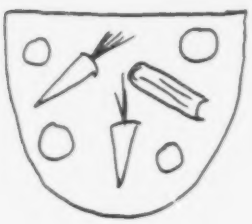
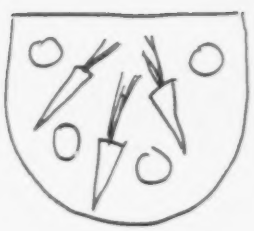
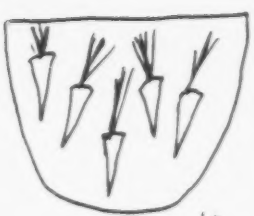
name







= carrot = celery O = onion

Why does the soup change its name?

name _____

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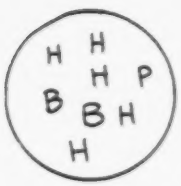
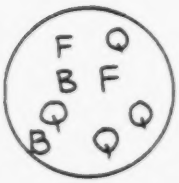
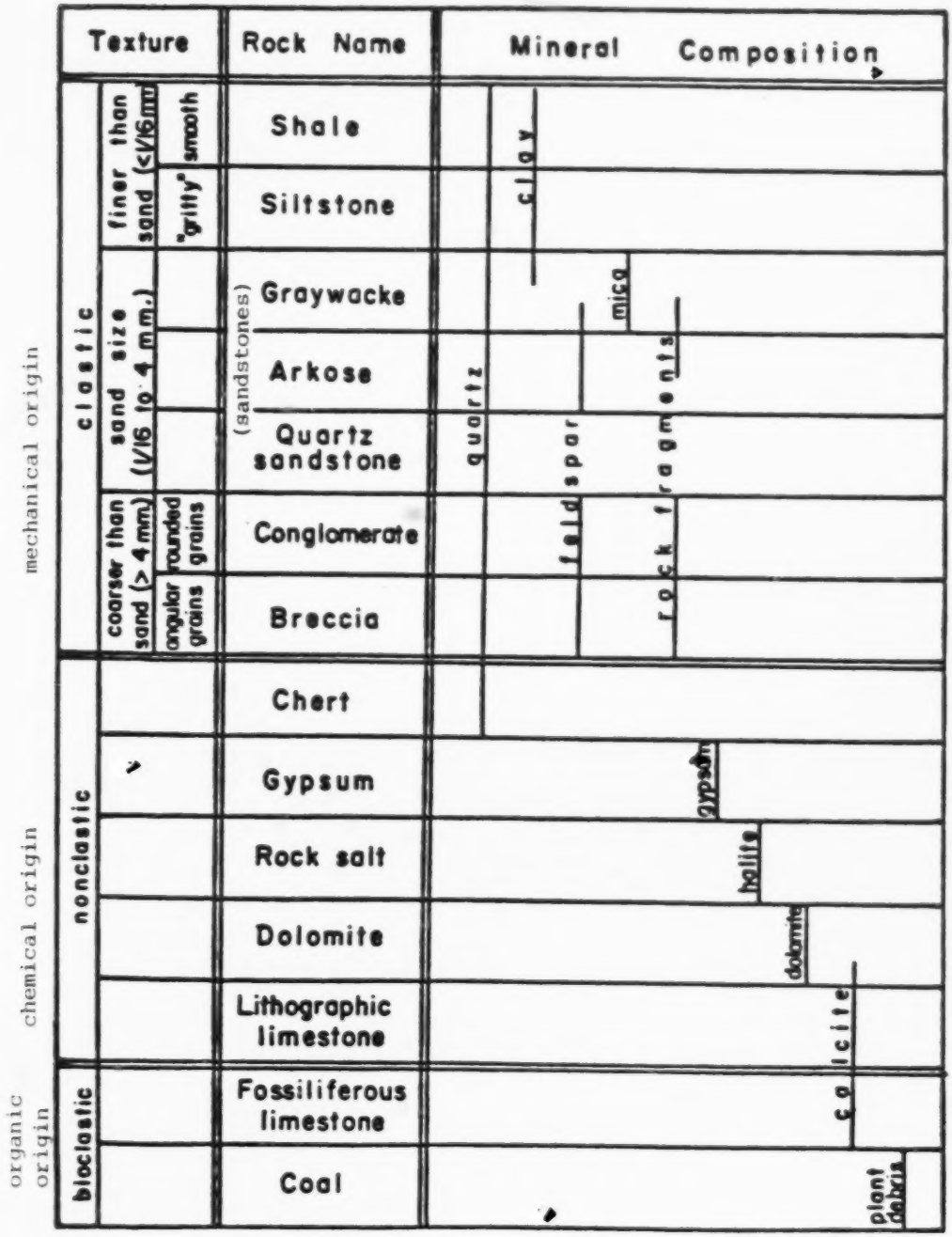




Sedimentary Rock Classification Scheme.

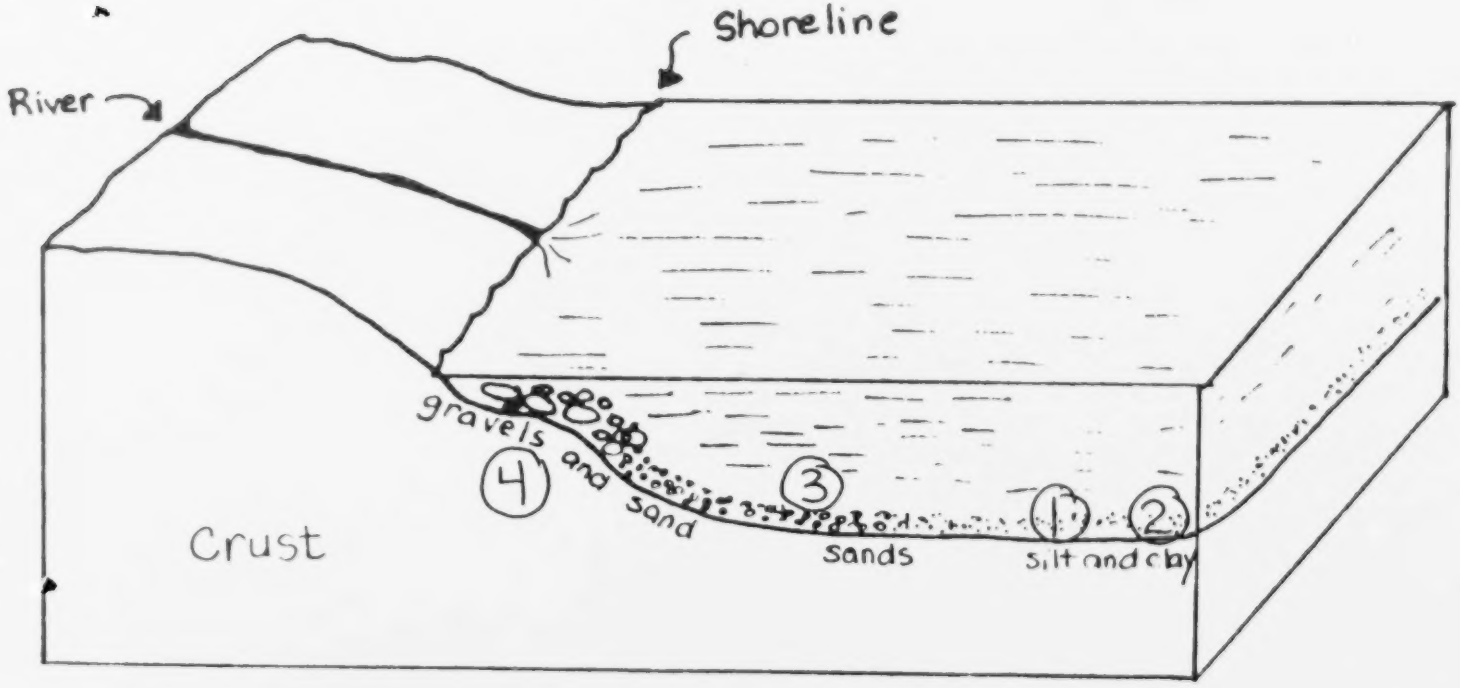


Teachers

WHERE ARE SEDIMENTARY ROCKS FORMED?

This figure shows that heavy and large particles, are moved by a river to the ocean, drop out first on the ocean bottom. The smaller the particles the longer it takes to settle out of the water. SEDIMENTARY ROCKS form when particles (broken down rocks) are glued together by natural cements. PLACE A NUMBER ON THE DIAGRAM WHERE YOU WOULD FIND THESE SEDIMENTARY ROCKS:

1. SILTSTONE
2. CLAYSTONE
3. SANDSTONE
4. CONGLOMERATE (hint: cemented together gravel)



name

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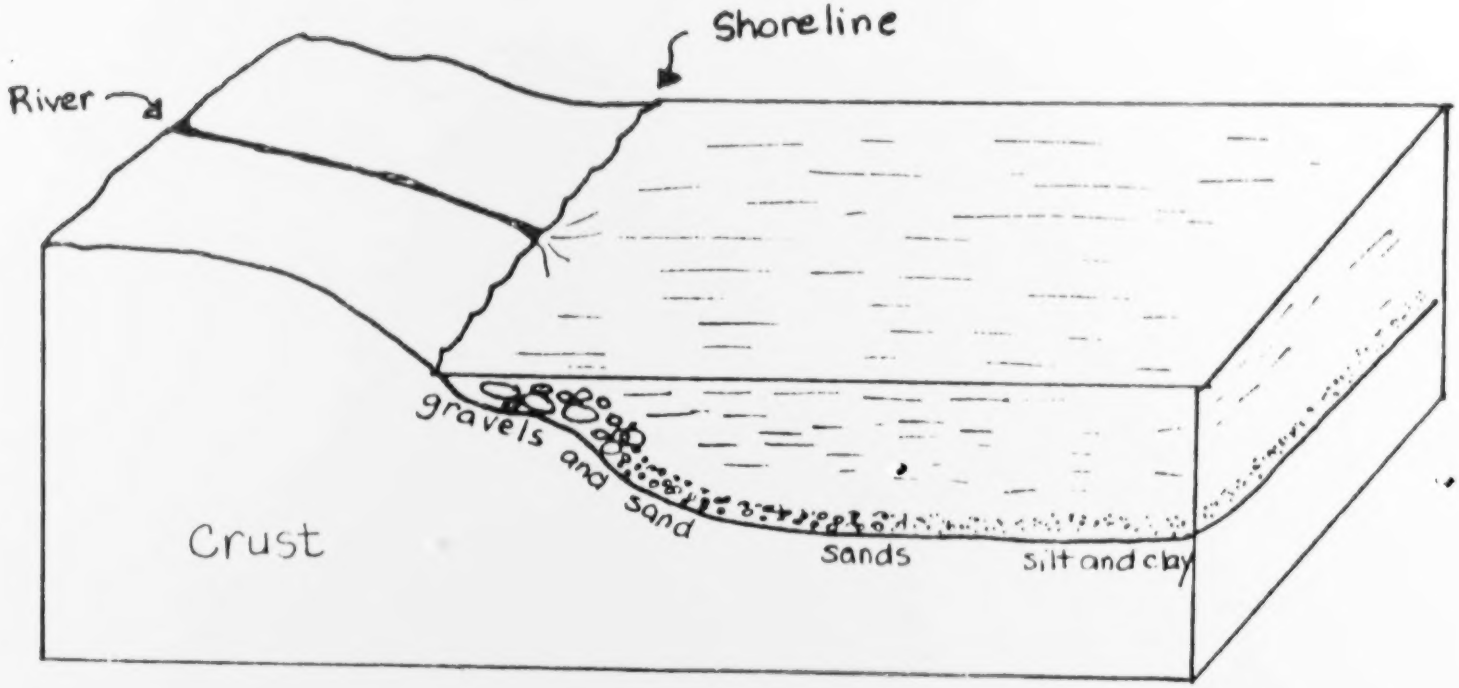
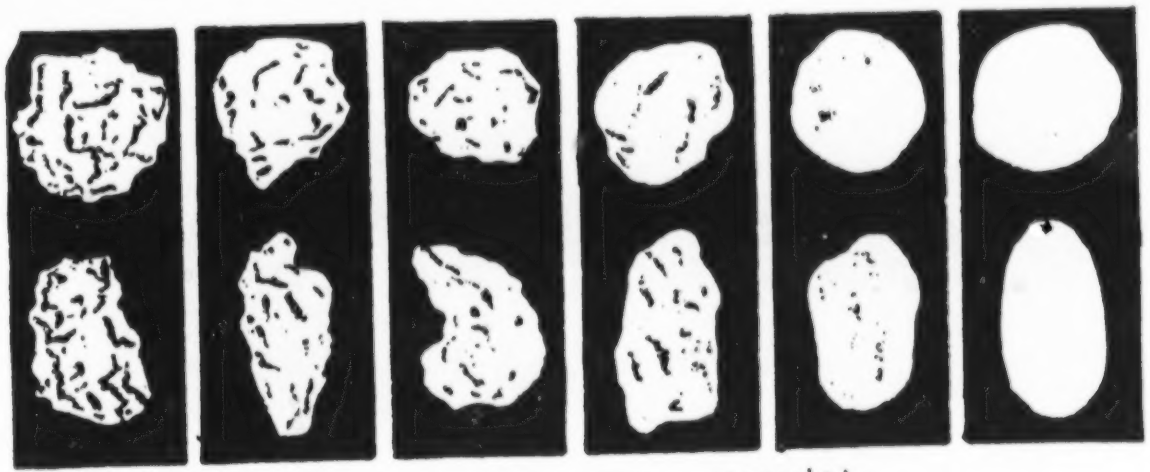


name _____

name teacher

WHY ARE ROCKS ROUNDED?

BILLY FOUND THESE PEBBLES ALONG A RIVER. SOME WERE VERY ROUNDED AND OTHERS WEREN'T. HE PUT THEM IN ORDER FROM ANGULAR TO ROUNDED. CAN YOU THINK OF THE REASON WHY THIS CAN HAPPEN AND WHY THEY CAN BE FOUND TOGETHER?



angular → rounded

the river's waters carry the rocks along, the pebbles are eroded, the longer pebbles are carried the more rounded they are, angular ones may have just broken

they can be found together because the river can erode new rock anywhere on its journey

name _____

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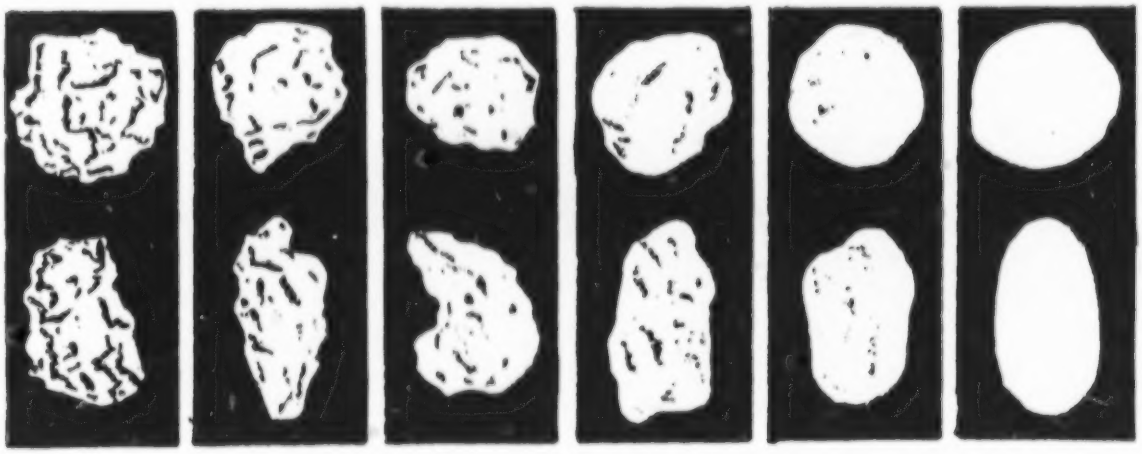
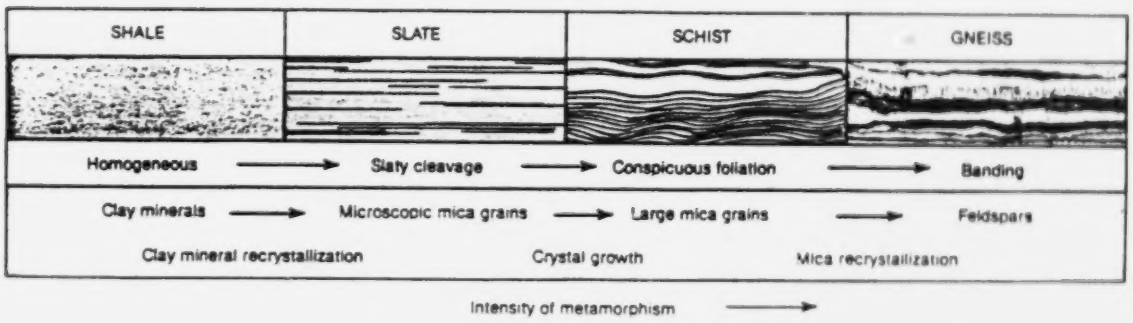
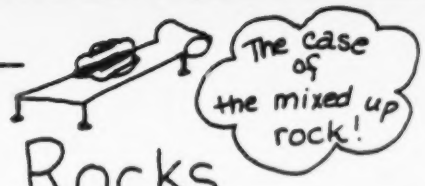


Classification Scheme for Metamorphic Rocks.

Texture			Rock name	Dominant mineral composition	Original rock
Foliated	fine grained	"smooth" fractured	Slate	clay	shale
		"shiney" layered	Phyllite	chlorite, mica, quartz	shale
	coarse grained	"layered"	Schist	mica, quartz, amphibole	shale
		"banded"	Gneiss	quartz, amphibole, feldspar	shale or granite
Nonfoliated	fine grained		Hornfels	amphibole, feldspar	shale
	coarse grained	no reaction with HCl	Quartzite	quartz	quartz sandstone
		reaction with HCl	Marble	calcite	limestone or dolomite



name _____



Metamorphic Rocks

have changed

Why? They used to be igneous or sedimentary rocks, but have changed under heat and pressure. Sometimes metamorphic rocks feel "different," but don't know why. Mildred Metamorphic is visiting her rock doctor to cope with her past life. Write a story about her "mixed up" emotions of having 2 lives.

have the students pick out - either igneous or sedimentary as her first life.

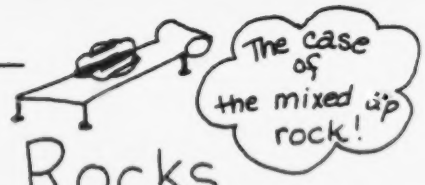
Key points that can be included:

igneous - life was hot, but cooled down later
inside the earth, had to escape
to cool down quickly

sedimentary - life was wet, but dried up
life was broken

2nd life metamorphic - life changed
pressure was great
life got a little hot, but
now stable

name _____



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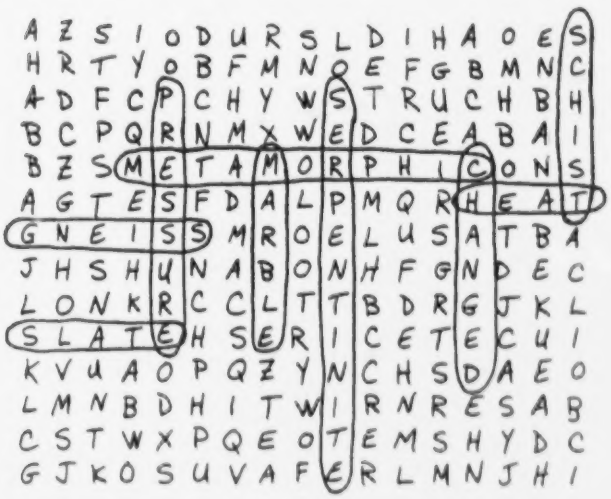
name ___teacher___

Metamorphic Word Search



7 schist
2 gneiss
3 slate
6 marble
4 serpentinite
5 heat
8 pressure
1 changed
9 metamorphic

Match the clues below with the correct words in the list above. Then, find and circle each of the words in the puzzle. Words go down or across only.

1. Metamorphic rocks are _____ rocks.
2. A nice metamorphic rock with a banded texture.
3. A metamorphic rock that is used to make pool tables and used to be used to make chalk boards.
4. The official state rock of California.
5. Metamorphic rocks have been changed by _____ and pressure.
6. Metamorphosed limestone
7. A metamorphic rock that has a layered texture.
8. Metamorphic rocks have been under great _____ so they have been squished and squeezed.
9. The type of rock that this whole puzzle is about.

name _____

Metamorphic Word Search

A Z S I O D U R S L D I H A O E S
H R T Y O B F M N O E F G B M N C
A D F C P C H Y W S T R U C H B H
B C P Q R N M X W E D C E A B A I
B Z S M E T A M O R P H I C O N S
A G T E S F D A L P M Q R H E A T
G N E I S S M R O E L U S A T B A
J H S H U N A B O N H F G N D E C
L O N K R C C L T T B D R G J K L
S L A T E H S E R I C E T E C U I
K V U A O P Q Z Y N C H S D A E O
L M N B D H I T W I R N R E S A B
C S T W X P Q E O T E M S H Y D C
G J K O S U V A F E R L M N J H I

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Teacher's Sheet- have student "find" 12 rocks near their home or school. Use an egg carton for easy storage.

MY ROCK COLLECTION

	Area Found	DESCRIPTION	What you think it should be called?
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			

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11.			
12.			

ROCK IDENTIFICATION FORM

specimen #	rock name	origin	rock type	mineral composition	texture	diagnostic characteristics